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CAUSAL BOTANY.

CAUSAL BOTANY;

OR

A TREATISE

ON THE

Causes and Character

OF

CHANGES IN PLANTS,

ESPECIALLY OF

CHANGES WHICH ARE PRODUCTIVE

OF

SUBSPECIES OR VARIETIES.

BY

DAVID BISHOP.

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TO

THE RIGHT HONORABLE

THE EARL OF ELGIN AND KINCARDINE,

THIS VOLUME,

IS,

WITH PERMISSION,

Respectfully Dedicated,

BY

HIS LORDSHIP'S MOST OBEDIENT

AND VERY HUMBLE SERVANT,

DAVID BISHOP.

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*** *In consequence of the negligence of the Printer by whom a portion of this Volume (extending from page 57 to page 124,) was printed, a number of slight inaccuracies have occurred. For these the Author has to solicit the indulgence of the Reader; but, as they are sufficiently obvious, and do not in any instance materially affect the sense of the work, he deems it unnecessary to particularize them.*

CAUSAL BOTANY.

INTRODUCTORY OBSERVATIONS.

In the visible world, few objects present themselves to our view, more worthy of notice than the vegetable productions of the soil. By their beauty they please; by their innate virtues they heal; and by their nutritive properties they support: while to the philosophic observer, their distinctions, manner of increase, growth, &c. display an order and harmony which evince the wisdom and power of the Creator. In almost every nation, they constitute the principal food of the inhabitants; and as they unite the most distant nations in the bonds of commerce, they therefore tend to the dissemination of knowledge, and the general welfare of the human race. In short, their value is inestimable, and their study an object of the highest importance.

That a scientific knowledge of plants enables us to reap advantages from them, which we otherwise could not, is most obvious. The distinguishing and arranging of species,—the ascertaining of their virtues and uses,—and the discovery of the means most conducive to their health, increase, and improvement, are researches highly beneficial to the community; and it is from those who engage in them, availing themselves of a scientific knowledge,—that is, of a knowledge of facts grounded on demonstration and experience,—that their labours prove eminently successful, and so highly advantageous. Yet, obvious as this is, some have affirmed a scientific knowledge of plants to be of little or no service to those engaged in their culture: the opinion, however, betrays so great ignorance, that it scarcely merits a serious refutation.

To the cultivator, a knowledge of Pathological and Physiological Botany is most essential. If a plant is attacked by a disease, how necessary is it that he should know the cause, and a remedy, if such may exist?—If a new variety presents itself to his view, how necessary is it that he should be capable of forming some idea of its worth, so that his care may not be extended to an object that will never reward him, or withheld from an object that might prove of greater

service to the community, than all the labours of his life united? I do not contend that it is necessary his knowledge should extend to the numerous and wonderfully diversified productions of every region of the earth, or that it should equal the knowledge of the most eminent botanists: but I contend, with respect to the particular objects of his care, that, if possible, it should be surpassed by none. Indeed, if there is aught in a scientific knowledge of plants that can tend to the general welfare, as there unquestionably is, it is only by its being in possession of those whose employments enable them to avail themselves of its advantages, that it can prove of real service.

That a man can perform the operations of ploughing, digging, sowing, and reaping, without his ever having once heard of the sexes of plants, or without being able to distinguish a vegetable monster from a variety of its species, is a well-known fact; and that such a person may prove highly serviceable to society, by adopting the modes of culture which he sees others practise, will be readily allowed: yet society must not look to him for discoveries or improvements: had all men been alike dull, or cautious and wise as he may imagine himself to be, the world would have been still in its pristine ignorance.

It is to men of genius and research that the community owes its advancement in that knowledge, the exercise of which is necessary to its well-being: and as none can foretell the birth of such men, or point out the station of life in which they may appear, none who possess an ordinary share of discernment, and who have the general welfare at heart, will ever be found to advocate the growth of ignorance in any class or body of men whatever: in short, it is only the uninformed, the unprincipled and illiberal, who will.

Some, perhaps, may imagine that a person engaged in scientific pursuits is apt to neglect his more important duties in consequence. But this is only the case, when the subject of his researches is foreign to that of his duties; and not when his researches tend to the advancement of his knowledge, or power in performing them. To contend that a scientific knowledge of plants is foreign to the employments of the Horticulturist and Agriculturist, is absurd. Indeed, the more that we examine or inquire into the advantages attending a scientific knowledge of plants, the more we will be convinced of its importance; for although, in horticulture and in agriculture, knowledge highly useful may be deduced from occurrences the most simple and obvious,—yet, as we advance in improvement, discoveries are not to be effected with the like facility, nor are

they to be effected otherwise than by strict observation and research.

At present, the cultivation of the soil, and the modes of culture most suitable to the different kinds of grain, pulse, and culinary vegetables, or that class of plants from which mankind derive their principal support, is so generally and perfectly understood, that there is little prospect of farther improvement, or of important discoveries being made respecting their culture.* It may even be asserted, without fear of contradiction, that as good crops have already been produced of the different varieties of grain, pulse, and culinary vegetables now in being, as ever there will be of the same varieties at any future period. But as superior crops may be obtained from superior varieties, it follows, that the discovery of superior varieties in a particular manner claims the attention of the cultivator. To enable him to discover these, some may imagine that the mere sense of vision is alone sufficient: but ex-

* If we compare the methods of treatment recommended by Mr. Philip Miller, an author who lived a century ago, with those recommended by modern authors on agriculture and horticulture, we shall find, so far as it relates to the culture of grain, pulse, and culinary vegetables, that there is scarcely any thing in modern practice that can be called new, or that deserves the name of improvement.

perience proves the contrary, and shows that varieties of the greatest merit are scarcely more liable to be trod under foot by the beasts of the field, than by the inattentive and ignorant of the human race. They are even such as oftentimes escape the observation of the best-informed and most attentive; nor can a doubt exist, of numbers of valuable varieties being lost, not so much from inattention or carelessness on the part of observers, as from an inability to discern that they are such.

Of the different subjects of botanical investigation, there is none from a knowledge of which more substantial good is likely to arise, than that of the plants commonly known by the name of Varieties. To the Botanist and Cultivator, the causes of their origin, and the character of their distinctions, are inquiries of the first importance; nor is more required to convince any one how essential a knowledge of this branch of Botany is to improvement, than a reference to plants that are known by that appellation. By means of them, we not only reap the fruits of our own labours, but of generations that have long ceased to exist. By them, the produce of our gardens and fields are not only increased in a tenfold degree, but the quality of the produce is improved in a still greater proportion. In them,

we perceive the labour and assiduity of man triumphing over the sterility of unassisted nature, and succeeding in giving birth to a race of beings, calculated to supply his wants in a manner that original species never could have done.

The difference between varieties that have sprung from the same species, fits them for different purposes, and for different soils, situations, and climates. Some, by reason of their robust natures, are winter vegetables; and others, by being early, are spring vegetables: while some are in perfection in summer, and others in autumn. The fruit produced by some is fit to eat when pulled off the tree; while the fruit of others is valuable by reason of its keeping till that season when nature rests to recruit her strength. Thus, in edible plants and fruits, we are supplied with an agreeable change throughout the year, from a difference in varieties that have sprung from the same species.

In the earlier ages of the world, no idea could have been entertained of the excellence some varieties have attained over their originals. Who, upon viewing the wild cabbage that grows along our sea-coasts, would ever imagine that Cauliflower or Brocoli would have been produced by

the same? Or, who would expect the well-formed apple of a pound weight from the verjuice plant in our hedges? Many instances might be noticed, of original species that are scarcely fit to be eaten by the beasts of the field, the varieties of which afford a nutritious and wholesome food for man. Upon comparing the original variety of the *Daucus carota*, the *Pastinaca sativa*, and some others indigenous to our climate, with their varieties produced by culture, we are struck with their great inferiority, and cannot help reflecting on the hapless condition of that hungry savage who first taught us their use, for nothing short of the greatest privation could ever have led to that discovery.* Indeed nothing is more obvious,

* The ascertaining the fitness of different vegetables for food, must have been the work of many ages, for mankind are averse to eat of plants the properties of which are unknown: indeed, few can be prevailed upon to taste a plant, the virtues of which have not been previously ascertained. But notwithstanding this, no country has been discovered, inhabited by human beings, who were not perfectly acquainted with all its vegetable productions that might be used for that purpose. The scientific philosopher possesses no claim whatever to their discovery: the merit belongs to the illiterate savage, who, when pressed by hunger, has oftentimes been compelled to allay its cravings, by using as food, substances of the qualities of which he was ignorant. It is not to be supposed, however, that curiosity, or the desire to know, had not its share in the discovery of edible species, though it is obvious that the more

upon comparing original species with their Varieties produced by culture, than that we, by means of the latter, enjoy a vegetable food far preferable to that of our forefathers,—a circumstance from which it may be inferred, that posterity is destined to enjoy a better than that which we do now. For although it is reasonable to believe that there exists a degree of excellence attainable by Varieties over the species whence

pressing demands of hunger must have been the principal cause that led to their discovery. As a proof of this, it may be observed, that we hear of no attempt having been made by man in a civilized state, unless when compelled by famine, to use any species of vegetable for food that was not previously known as fit for that purpose; nor is it likely that man in his natural state would use that of which he was ignorant, until no other could be obtained. The inhabitants in the neighbourhood of Orford, and along the Suffolk coast, in a season of great scarcity, had recourse to the seeds of the *Pisum maritimum*; and since then, they have occasionally used the same. In the island of Coll, one of the Hebrides, Lightfoot informs us that the natives, when hard beset for food, were in the habit of tilling their pastures, so that they might obtain the roots of the *Potentilla anserina*, and thus prevent themselves dying of hunger. Along the coast of Aberdeenshire, the *Crambe maritima*, or sea-kale, has been long in use amongst the poorer classes, though but lately introduced into our gardens. These and similar instances plainly show the discovery of edible plants to have been effected by those who, being unable to obtain their accustomed food, were compelled by dire necessity to use that to which they were strangers.

they have sprung,—yet as that degree is unknown, and as it is probably beyond the power of man, of cultivation, or of time, to determine the same, we are justified in regarding it as progressive, and in considering the production of a good variety as the sign or harbinger of a better.

The power of distinguishing Varieties, and of forming some idea of their worth at sight, is an attainment much to be desired, because valuable Varieties may sometimes appear to those who have it not in their power to prove them by trial; and if they have, the probability is, that the means to be employed require more care, time, and attention, than they are disposed to bestow on plants, the merits of which are doubtful: whereas, were such persons capable of forming an estimate of the worth of Varieties from their appearance, then would they use means for their preservation, whenever their appearance was found to indicate superiority. That this is an attainment of considerable importance, will be readily allowed; yet, that it in some cases requires the most strict attention, appears from the circumstance of Varieties being oftentimes valuable, though not conspicuously so. Let us suppose, for instance, that in a field of wheat there exists a plant, a new variety, having two more fertile joints in its spike, and equal to the

surrounding wheat in every other respect: a man accustomed to make the most minute observations, would scarcely observe such a variety, unless otherwise distinguished by some peculiar badge; nor would any but a person versed in plants, know that it was of superior value if placed before him. How many Varieties answering this description may have existed and escaped observation, which, had they been observed and carefully treated, would have proved an invaluable acquisition to the community. The number of fertile joints in the spike of the wheat generally cultivated, varies from eighteen to twenty-two; and the inhabitants of Great Britain and Ireland amount to nearly the same number of millions: therefore, as the wheat produced in those islands has been of late years sufficient, or nearly sufficient, to supply the inhabitants thereof with bread, it is evident that a variety with two additional fertile joints, and equal in other respects to the varieties at present in cultivation, would, when it became an object of general culture, afford a supply of bread to at least two millions of souls, without even another acre being brought into cultivation, or one additional drop of sweat from the brow of the husbandman.

If the same Varieties were repeatedly produced by culture, there would not exist that

necessity for strict observation and skill on the part of observers; because, if a variety was lost or destroyed, we might look forward to its re-appearance: or did we possess the power of producing Varieties, and of producing them late or early, tall or dwarf, sweet or sour, or just as we might wish to have them,—then might we plead an excuse for inattention. But experience shows, that when a variety is lost, it is for ever lost; and the slightest reflection cannot fail of convincing us, that our power of producing them is most limited. Indeed, our knowledge only enables us to produce those of the intermediate kind; while Varieties that confer extension or excellence, are as likely to be produced from the seed sown and treated by the humble labourer, as from that sown and treated by the ablest horticulturist, the most skilful botanist, or most profound philosopher of the age.

From these remarks, it is obvious that the benefits mankind derive from the Varieties produced by culture, are numerous and important, and that the discovery of those of merit is an object highly deserving of our attention. Yet, though this branch of botanical research is of vital importance to society, the opinions of the scientific botanist are not so favourable to its advancement as could be wished. Causal dis-

tinctions are, with him, of secondary consideration; while the same general character, *viz.* that of natural instability, or a proclivity to change, he indiscriminately applies to all plants, the distinctions of which are secondary. But this procedure, permit me to observe, is neither justified by experience, nor the principles of the science he professes. The science of Botany does not teach us to distinguish plants by the *a. m.* or *a. d.* in which they were produced, but by their difference in *structure* or *form*, and by the power they possess of transmitting their distinctions to posterity. These are the means by which we arrive at a knowledge of their true character; and he who decides accordingly, will not fail to discover that certain of the popular opinions at present entertained of Varieties, are most erroneous and wholly unworthy of his support.

In Botany, and indeed in every science to a knowledge of which strict research and investigation is necessary, we are all too apt to pay a servile obedience to general received opinions. Opinions on subjects of this description, that have once obtained the general assent, seldom experience an after investigation: for although there exists in man a desire to be informed, yet he is impatient of suspense: he esteems knowledge, but would willingly forego that labour of

mind necessary to obtain it. This disposition on the part of man, as may be easily conceived, induces him to rely much upon the testimony of others:—in doubtful cases, he adopts the opinions of those whom he thinks most entitled to credit; and opinions that have obtained general assent, he receives without reserve. Now this conduct, however justifiable in some respects, is nevertheless alike favourable to the dissemination and establishment of error as of truth; and that it is the principal cause why the opinions generally entertained of Varieties are, in some respects, so very incorrect, admits of no doubt: for had the elucidation of their character been a subject of more general inquiry, these opinions would not have been so prevalent as we at present find them, but would have given place to others more agreeable to nature and experience.

In order that the reader may be in no doubt either respecting the opinions generally entertained of Varieties, or the authority upon which they may be said to depend, the following remarks are here inserted from the *Philosophia Botanica* of Linneus:—

"Varietates tot sunt, quot differentes plantæ ex ejusdem speciei semine sunt productæ.

"Species varietatem sunt, *magnitudo, plenitudo, crispatio, color, sapor, odor.*" p. 104.

Respecting the origin and duration of Varieties, this author observes:—

"Varietas est planta mutata à caussa accidentali: *climate, solo, calore, ventis,* &c.: reducitur itaque in *solo* mutato." p. 104.

"Varietates culturæ opus esse, docet Horticultura, quæ easdem sæpius et pruducit, et reducit." p. 105.

As further evincing the power of culture in producing Varieties, he observes:—

"Horticulturæ mangonium produxit flores *plenos*, fructus *horæos*, caulium *turiones*, herbas *altiles*: *capitatas* teneraque *olera*; hæ sibi relictæ in solo macro sylvestrem induunt naturam et naturalem." p. 251.

He then, in support of these assertions, quotes the following lines from Virgil:—

"Vidi lecta diu, et multa spectata labore
Degenerare tamen: ni vis humana quotannis
Maxima quæque manu legeret: sic omnia satis
In pejus ruere, ac retro sublapsa referri."
Virg. Georg. 1.

Agreeable to these quotations, all plants produced from seed, and differing from the generality of their species, are Varieties; and all plants of that description are of a variable character, and prone to relapse into their original state or condition.

Now, though all plants causally distinct, or that differ from the primitive character of their species, may be termed *Varieties*, yet all plants of that description are not *Varieties of their Species*; nor are all plants of that description prone to resume the primitive characteristics of the species whence they sprung: and hence the impropriety of assigning to them the same general character.

Upon mature reflection, no man can believe a diseased, a mutilated, or a luxuriant plant, to be a variety of its species; nor can he believe that a plant, causally distinct, is any other than a secondary species, or a variety of the species from which it sprung, when he knows it to be endowed with the power of transmitting its distinctions to posterity by natural generation, or in other words, by seminal reproduction.

Linneus, we find, limits Varieties to plants that differ from seed; but the generality of

authors pay no attention whatever to that particular: on the contrary, every plant remarkably distinguished from others of the species to which it belongs, is by them accounted a variety of that species. The aged *Holly*, the leaves of which have lost their prickles, they place amongst Varieties; and in all works on botany and gardening, plants with variegated leaves are styled Varieties, though it is well known that their variegation is only a disease. Certainly, if this is justifiable in plants, it must in animals; and upon this principle, therefore, when men turn bald by reason of old age, they become varieties of the human species; and men blotched by leprosy, or deformed by rheumatism, like variegated and curled-leaved plants, must be looked upon as distinct varieties. But, truly, nothing can be more unphilosophical than to suppose, that the affections attendant on age, disease, and luxuriance, constitute the individuals affected, varieties of their species. If aged, diseased, and luxuriant affections are to be distinguished as varieties, let it be understood that they are only meant as varieties of aged, diseased, and luxuriant affections,—and not of species: for as neither the affections of age, disease, or luxuriance, are specific distinctions, they cannot constitute a plant a variety of its species.

A variety of its species is a species of secondary origin, that differs from the primary species whence it sprung, in possessing different properties or qualities, which properties or qualities it is endowed with the power of transmitting to posterity. When placed before the most skilful Botanist or Naturalist, he is unable to ascertain whether its characteristics are secondary or primary; whereas, decrepid, diseased, monstrous, and mutilated beings, are readily distinguished at sight. There is nothing in the state or condition of a variety of its species, that is either diseased or monstrous; although, in common with all other beings endowed with life, it is liable to those affections.

Regarding the relapsation of Varieties or Subspecies, it may be observed that the conclusion is not justified either by the distinctions of the plants themselves, or by experience; and that, though some of them are most changeable, yet, upon strict examination, it will be found that their instability does not proceed from a proclivity to change, or a tendency to re-assume the primitive characteristics of the species from which they sprung, but is merely the effects of their sexual intercourse:—a cause which, in many instances, produces the like instability amongst species that have existed from the beginning.

The belief that all causal distinctions depend upon the presence of the causes that produce them, is founded upon inaccurate and superficial observation. It is an opinion unsupported by facts, and has led to the most absurd and contradictory conclusions. The permanence of the distinctions that characterize the varieties of the human species, has induced some philosophers to contend that Blacks, Mongolians, and Europeans must have been originally distinct, and consequently that the Mosaic account of creation is false; while others, over zealous to defend this doctrine, have affirmed, in the face of the most incontestible proofs to the contrary, that the distinctions of the Ethiopian are peculiar to climate, and thus not only belie nature, but scripture; for could the Ethiopian, by a change of climate, change his skin, the leopard, by a similar process, might change his spots. It is not by reason of the former drawing his first breath upon the banks of the Niger, the Gambia, or the Senegal, that he becomes a Blackamore, or has wool upon his head instead of hair: it is because he is a distinct variety of the human species,—a variety that has been known to maintain its distinctions in different parts of the world for centuries. The permanence of his characteristics, however, by no means prove him to be of distinct origin: for the characteristics of every being, that is in reality a variety of its

species, are by nature permanent, though not immutable.

In the vegetable kingdom, Subspecies or Varieties, like original species, are distinguished by difference in *form, magnitude, proportion, colour, taste, smell, duration, fertility,* and *time of flowering;* and strict investigation shows, that when a difference exists in their structure or form, similar to that which exists between original species, it indicates a similar difference in their properties or qualities;—a fact which proves their distinctions to be grounded upon a difference in structure, and, like the distinctions of original species, to be naturally permanent or specific. For there is no reason whatever to suppose, that distinctions grounded upon a difference in structure depend, at the same time, upon a difference in external causes; because a difference in structure, that imparts different properties or qualities, is an acknowledged specific difference of itself; and to suppose other causes, in order to explain the permanence it confers, is to suppose more causes than are sufficient to account for that permanence,—a proceeding altogether at variance with the rules to be observed in philosophic reasoning.*

* Causas rerum naturalium non plures admitti debere, quam quae et verae sint, et earum phænomenis explicari sufficiant.
Newtoni Principia, p. 387.

As it frequently happens in inquiries of this description, that the real import of the subject is misconstrued by those who may favour a contrary opinion, or by those who may be actuated by prejudice, interest, or other motives, I shall offer a few remarks, not directly in support of the statements already made, (as these will be minutely explained in the sequel,) but in order to prevent any exaggeration or undue application of their meaning.

It has been asserted that the opinions generally entertained of causal distinctions, are, in many respects, incorrect or erroneous; and that, by the agency of secondary causes, species are produced which possess all the powers or capabilities of species that have existed from the beginning. Now, though both assertions will, upon examination, be found correct; yet some may from them infer, that all the opinions at present entertained of causal distinctions are incorrect, and that all the species now in being have been generated by the agency of secondary causes,—a doctrine that is neither advanced nor believed by the author of this volume.

That certain of the opinions generally entertained respecting the changes plants experience, are erroneous, cannot be denied; but that error

species, are [illegible] immutable.

In t[illegible] rieties [illegible] diffe[illegible] ta[illegible] i[illegible]

[illegible] all the changes [illegible] being the case.— [illegible] changes, the causes [illegible] are well known almost [illegible] All the operations of the [illegible] other than as many causes, [illegible] has taught him will produce changes in plants that greatly enhance their value; and it is his knowledge of these that crowns his labours with success. But there are other and not less important changes, which plants experience from culture, in producing which, design has, as yet, had no part, and of the character of which the most erroneous notions are generally entertained.

That species, or specific distinctions, are generated by the agency of secondary causes, is a fact of which there exists the most satisfactory proofs; yet of the species so generated, it must be allowed that all may be referred to the particular species from which they have sprung, with as much ease as original species may be referred to their respective genera;—a circumstance which shows that had one species only existed at the beginning, more than one genus would not now have existed. Nor is it to be supposed, in that case, that more than one species would have existed independent of the agen-

cy of man; for it is only amongst cultivated plants and domesticated animals, that Subspecies or Varieties of their species are to be found. It is human power, aided by adventitious causes, that gives them being, and produces that modification of matter upon which the permanence of their distinctions depends.

According to the writings of some theorists, to whom neither truth nor science is at all indebted, this world was once an atom, and when it grew sufficiently large, a plant and an animal were established thereon; these, growing and multiplying, peopled its surface, and finally, by difference in soil, situation, and climate, assumed that multiplicity of forms, properties, and peculiarities, which plants and animals now possess. But if that wonderful diversity we find amongst beings endowed with life, is causal or secondary, it is obvious that the same must have been the work of supernatural causes, or of natural causes under the direction of supernatural power: for although instances of the production of hybrid species in a state of nature, may sometimes occur, yet there is no instance of Varieties or Subspecies being produced in that state, far less of the higher distinctions which characterize the different genera, orders, and classes, of animals and vegetables. Indeed, the philosophic and considerate

part of mankind can only entertain one opinion respecting the origin of the generic and more remote distinctions of living creatures; and that is, that all such distinctions have existed from the beginning, and owe their beginning to a power that surpasses comprehension. Of the truth of this we have a satisfactory proof, in the impotency of nature to produce a secondary species; or, in other words, a permanent association of distinctions, independent of human agency.

Upon the whole, the generation of secondary species, by human agency, is a most interesting occurrence, and as such is entitled to particular attention. Yet there are other changes incident to plants, which, though less remarkable, are nevertheless highly deserving of notice. In short, there is nothing relating to the changes, or the causes of the changes, cultivated plants experience, that is wholly uninteresting, or that it may not be of service to know. But to ascertain every cause that may induce a change in plants, or to trace to their respective causes all the changes they experience, is probably beyond the utmost stretch of human perspicacity; yet to obtain a general and correct knowledge of the nature or character of the changes they experience, is certainly practicable; and I flatter

myself that the following pages will bear testimony to the truth of the assertion. But it must not from this be inferred, that in them an illustration of every difficulty, or an answer to every subtle question, is to be found. Nothing, indeed, is more easy, in inquiries of this kind, than to devise questions to which no satisfactory answer can be given. As an instance, if it is required to know the mutual limits of the animal and vegetable kingdoms,—the skill of the ablest naturalist does not enable him to decide the point: for although the great body of animal and vegetable species may be easily distinguished as such, yet there are creatures that hold an intermediate place, and which, without the breach of any known rule, may with equal justice claim the appellation of vegetable as of animal, and that of animal as of vegetable. In like manner we find species, which, from the striking resemblance their generic characters bear to two, three, or more genera, cannot be said to belong to any one of them; and we also find species so much alike, that they are frequently described as one and the same. If the naturalist meets with difficulties like these, in distinguishing beings the characteristics of which are primary, so he will in distinguishing beings the characteristics of which are secondary. Between the variety of its species, and the transient affection that vanishes

with the cause or causes that produced it, there are distinctions that continue during the existence of the individuals affected, independent of the causes of their origin; and there are others which sometimes admit of seminal renewal, though depending upon no visible cause. Thus, by imperceptible ties, we find the vegetable united to the animal,—genera united to genera,—species to species,—species to varieties of their species,—and varieties to dependent and transient affections. But however great the disparity of living creatures, or however intimate their affinity, they are only modifications of the same matter: they all consist of the same palpable substance; for that "dust they are, and unto dust they shall return," is a fact attested by every day's experience. Of that vital principle from which they derive their native energy, nothing can be said in the abstract: all we know of it is, that matter organized into fibre, vessel, and humour, is indispensable to its existence;—that the more perfect the organization, the more exalted it is;—that an injured organization lessens and destroys its powers;—that the fabric it rears in youth, although admirably adapted to its nature, and fit in every respect as an abode, is only a temporary residence, which having attained maturity, or the highest pitch of perfection, begins to fade, becomes irreparable, and at last uninhabitable.

In the following pages, I have attempted the elucidation of the various changes plants experience, in that way which I consider to be the most simple and explicit; nor have I ventured to advance or defend any position which I conceive a reference to facts will not fully justify. It has been my object to explain appearances according to nature and experience, and it now rests with a discerning public to decide of my success.

I have, of course, been led to some innovation as to terms, for which no apology is necessary, as the reader will easily collect their acceptation from the manner in which they are used. Should they prove inept or inelegant, let others more apt be adopted.

Whenever I have been under the necessity of dissenting from others in opinion, I have given my reasons for so doing. That the most respectful attention is nevertheless due to the opinions and suggestions of celebrated men, I allow; yet that they ever should remain open to fair and temperate discussion, is most essential to the increase and advancement of knowledge. If, at any time, theories have been advanced which experience will not confirm,—if conclusions have been agreed on contrary to just inference,—and

if attempts have been made to explain appearances in a manner in which they cannot be explained;—then it becomes a duty to abandon those authorities, and to submit our contrary conclusions to the test of general wisdom.

Should the following inquiries respecting the changes and the causes of changes in plants, contribute to the acquisition of botanical knowledge, by throwing additional light on the character of those plants commonly known by the name of Varieties, and thereby prove beneficial, not only to science, but to society, I shall not consider the time, labour, and research, this small volume has cost, to be vainly spent.

The first part, it will be observed, comprises a complete though miniature view of *causes* and their *effects* on vegetables; the second treats of *affections* that depend on the presence of the causes whence they proceed; and the third comprises a full account of the origin and character of acquired distinctions, which exist independent of the causes of their origin,—which are transmitted to posterity by natural generation,—and which distinguish certain plants, that are the offspring of primary species, as *Varieties*, or *species of a secondary origin*.

CAUSAL BOTANY.

PART I.

OF THE CAUSES AND CHARACTER OF CHANGES IN PLANTS.

Botanical researches of the scientific kind may be divided into three branches, namely,—Chemical Botany, Systematic Botany, and Causal Botany. The first relates to the discovery of the virtues and uses of plants; the second relates to their arrangement agreeable to their affinities; and the third and last relates to the causes and the character of the changes they experience.

The discovery of the virtues and uses of plants, when conducted on scientific principles, is performed by analysing them,—a process which is sometimes effected by the agency of *fire*, and sometimes by *water*.*

* All plants, by chemical analysis, are found to consist of particles of earth, oil, water, and air, with a portion of iron; and it is from these the various acids, mucilages, gluten, farina, sugar, aroma, colouring matter, and other extracts, are obtained.

The arranging of plants agreeable to their affinities, is performed by observing their difference in *structure:* the *less* that difference, the greater their affinity, or more intimate their relation; and the *greater* that difference, the greater their disparity, or more remote their connexion. The justness of this rule of distinction is universally allowed: indeed, there exist cogent reasons for asserting that all specific difference, not only in plants, but in organized beings, depends upon a difference in their structure or organization.* General experience, and the most attentive observation, lead to this conclusion; and we have only to refer to the different Systems of Botany that have appeared from time to time, in order to be assured that a difference in *form* has ever been accounted the most certain indication of a specific difference.†

The elucidation of the causes, and character of the

* If we take a view of the visible world, and strictly examine the nature of particular bodies, we will find reason to conclude that they all consist of the same sort of matter or substance, and that all the diversity or difference we observe among them, arises only from the various *modifications* and *different connection* or *adhesion* of the same primogenial particles of matter.—*Martin's Phil. Britan.* vol. i. p. 3.

The specific qualities of any mass of matter are obviously derived from the arrangement, disposition, or combination of its component particles, as to *mode* and *proportion;* because universal experience manifests that an alteration in the latter induces, in the same rate, an alteration of the former.—*Aitken's Elements of Physic,* vol. i. p. 4.

† By Linneus, the generic distinctions of plants are deduced solely from a difference in the number, figure, proportion, and situation of their several parts of fructification; while their specific distinctions he deduces from a difference in the form of their leaves, stems, and roots, though in some instances from a difference in their fructification likewise.

changes plants experience, or that branch of botanical research of which this Volume professes to treat, includes several minor branches or subjects of inquiry,—as that of Pathological Botany, which relates to the diseases and accidents of plants; and that of Applied Botany, which relates to their treatment and culture. In short, it includes all that can happen to plants in accordance to nature, by design, or otherwise. Yet, amidst this diversity, it is to be observed that the *causes* and the *character* of the changes they experience, are the sole subjects of investigation.

OF THE CAUSES OF CHANGES IN PLANTS.

Our information respecting the causes that produce changes in plants, can only be obtained by referring to the changes or effects they produce. Their effects are the sole proofs of their power; nor of their power only, but, in many instances, of their existence: for although certain of the causes that produce changes in plants, are visible, yet others are invisible, and are only known to exist by their perceived effects.*

* There are some causes which we cannot make visible to our sight: we can only infer their existence from their perceived effects. This circumstance perpetually occurs in natural philosophy. It is not, therefore, a decisive evidence against the existence of a cause, asserted to be acting, that we cannot visibly shew it. If, from a careful investigation and comparison of effects, we can with just reasoning infer its existence, we do all that we can effect in a state of imperfect knowledge. In every acid, we infer the presence and action of that acidifying element which we call oxigen, though human science has not yet been able to view this agent in any separate state.—*S. Sawrey on the Effects of Venereal Poison*, p. 146.

That all the changes in the state or condition of plants are causal, and proceed from causes that are either *internal* or *external*, is a fact which requires no proof.

That all changes in the state or condition of plants are brought to pass or effected by external agency alone, or by the co-operation of that agency with that which is internal, is obvious from the well-known fact of no plant being able to live, grow, propagate, or perform any of the functions essential to its existence, or the perpetuation of its species, independent of that agency. It is by reason of the genial warmth of spring, that the *oak* puts forth fresh leaves at that season; and it may be presumed that the inclemency which prevails towards the end of the year, is the principal cause of its losing them: but the cause why it loses its leaves towards the close of the year, while the *bay* continues to retain its leaves, must exist in itself. Hence the existence of the *internal* and the *external* causes of the changes plants experience; and hence the necessary co-operation of the latter with the former in producing those changes.

That certain of the changes or effects produced by the conjoint agency of internal and external causes, become internal causes, and co-operate with others pre-existing, in producing different changes or effects, is a position which none can reasonably question, amidst the innumerable proofs which the living bodies of plants and of animals evince of its reality. It is to be observed, however, that it is amongst cultivated plants and domesticated animals that proofs of this multiplication of causes and effects are so very apparent.

From these remarks, it appears that causes can only be

known by their effects; that they are of two kinds—*internal* and *external;* that it is only by the influence of the *external* that the *internal* can act; and that changes or effects, generated in the bodies of plants by their combined agency, become the causes of other changes or effects.

With these obvious facts in view, we shall now inquire into the different internal and external causes of changes in plants.

Of Internal Causes.

The *internal* causes of the changes plants experience are *versal, general, partial,* and *particular;* that is, existing in all plants,—limited to plants of the same species,—limited to a greater or less number of plants belonging to the same species,—and limited to an individual or plant.

The first in order is that with which "full nature swarms," namely, *life,*—a principle which disposes plants and all organized beings to the performance of their various functions according to nature,—which is of primary origin, and transferable to posterity by natural generation.

The second in order is a *specific difference,* the presence of which is the cause of the same uniform changes in all plants of the same species, and of different changes in plants of different species,—is transferable to posterity by natural generation, and is of primary or of secondary origin.

The third in order consist principally of acquired properties or qualities: yet in some species, as in those of the

class *Diœcia*, the sexes are known to exist as a natural and internal cause of plants being different, though of the same species. *Internal causes of partial influence* are of two kinds, therefore,—the acquired and the natural. Thus, plenitude in the flowers of the *Anemone Hepatica* is an acquired distinction, and a cause why plants of that species, when so distinguished, are more tender, and do not flower until three weeks or a month after the plants that retain their natural character; and in the *Cannabis sativa*, the existence of male and of female plants is a natural distinction, and a cause why the plants that bear the male fructification do not attain the size or the external figure of those that bear the female fructification, as it is also the cause of their coming sooner into flower, of their being sterile, and of their more limited duration.*

Of internal causes of the fourth denomination it may be observed, that as they are the marks of identity by which plants of the same species, whether male, female, or otherwise distinguished, are known as distinct plants, we are justified in regarding them as acquired, and as innumerable. That some may entertain doubts of the existence of this wondrous diversity, amongst beings that are of the same

* The disjunction of the sexes, as in plants belonging to the class *Diœcia*, is generally considered as the only instance of a natural variety, amongst plants of the same species. It may be observed, however, that in plants which belong to species that are accounted *diœcious*, there seldom exists a complete or entire separation of the sexes, though appearances would almost compel us to believe that it was invariably the case. Hence it is by no means improbable that other species have their sexual oscillations, which, though less apparent, are not less real, or less natural. That this is the case, appearances, at least, induce us to believe.

species, is by no means improbable: in all species, however, this diversity would appear to exist; and though we may not be able to point it out in some species, yet in others its existence is most apparent. Thus, amongst the eight hundred millions of human beings that are supposed to inhabit the world at this time, two are not to be found that cannot be distinguished; nor is it probable that amongst the countless thousands which have existed from Adam till now, any two have existed so much alike, as that they could not be sworn to in a court of law as distinct. In other species, whether animal or vegetable, no reasonable doubt can be entertained of the existence of the like interminable diversity; nor can a doubt be entertained of its frequently proving a source, not only of more marked, but of more permanent and conspicuous distinctions.

Of External Causes.

The external causes of changes in plants, though exceedingly numerous, may be considered as of two kinds—the *versal* and the *partial*. When versal, their influence extends to every species and to every individual; and when partial, their influence only extends to a greater or less number of individuals that are of the same species, and not to every individual.

External causes of *versal* or *universal* influence are five in number, namely, *earth*, *air*, *light*, *heat*, and *moisture*. These, it will be observed, are indispensable to the life of plants, to their propagating themselves, and to the performance of every function which internal or indwelling causes may excite. Yet, as it is not from *earth* that plants derive

their whole nourishment, and the power of exercising their functions; nor from *air*, nor from any one of the above-mentioned causes in particular, but from them collectively, it follows that, strictly speaking, there is but one *versal external cause* of changes in plants, and that it exists in *earth*, *air*, *light*, *heat*, and *moisture*, collectively. When a plant continues to perform its functions in obedience to this compound or five-fold cause, it is said to perform them in obedience to nature: if it possesses certain marks or properties, which it transmits to its seminal offspring in obedience thereto, then are these marks or properties to be considered as specific; but if it possesses certain marks or properties, which it is incapable of transmitting to its seminal offspring in obedience thereto, this incapacity is a manifest proof that the said marks or properties are not specific, but depend on a diseased organization, or on the presence of certain external causes that are not *versal*, but of limited influence.

External causes of partial or limited influence are of two kinds—the *local*, and the *erratic*.

Local causes are those of *soil*, *situation*, and *climate*; and erratic causes are *wounds*, *bruises*, *winds*, *storms*, &c. Of these it is to be observed, that they produce different changes or effects by their differing in kind, by their differing in degree, and by their acting in conjunction: nor by their acting in conjunction with one another only, but by their acting in conjunction with internal causes of every denomination. Hence that wondrous diversity we behold amongst plants of the same species, and of which external agency of partial influence is to be considered as the cause. For as all changes in the state or condition of plants are

effected or brought to pass by external causes,—and as it is evident that the versal external only enables them to perform the functions essential to their existence and the perpetuation of their respective species,—it must be, therefore, that all the irregular changes they experience are effected by causes of partial influence.

It is worthy of remark, that there are certain partial external causes that may be termed *applied* causes, from their being employed by man in the cultivation of plants; and that, though they do not materially differ from those already mentioned, yet, under the direction of man, they become the causes of effects that never can happen in a state of nature. Now as these, when under the direction of man, become the causes of effects which never can happen to plants in a state of nature, it follows that human agency is a cause of changes in plants. Indeed, human agency is the cause of the most remarkable changes plants experience. All the operations of the cultivator have their effects; and some of these operations, though most simple, prove a fertile source of changes in the plants cultivated. In some instances, the planting of nearly allied species together, is a cause of their intercommunication, and consequently of their producing a hybridous or mixed offspring, —an occurrence that might never have taken place were they left to themselves, or permitted to inhabit the stations assigned them by nature.

The result of this inquiry is, that the causes of changes in plants are *versal* and *partial*, or, in other words, *natural* and *incidental*; and that the former are the causes of all changes that are of regular occurrence or attendant on *duration*; while the latter comprise the causes of all changes

that proceed from *soil, climate, disease, culture,* and other causes.

ON THE CHARACTER OF THE CHANGES NATURAL AND INCIDENT TO PLANTS.

Change in *form, proportion, magnitude, colour, taste, scent, duration, fertility,* and *time of flowering,* are the principal changes plants experience; and *age* or *duration, soil, situation, climate, disease, luxuriance,* and *culture,* are the principal causes whence they proceed.

Changes attendant on *duration* are the same in all plants of the same species: changes produced by difference of *soil, situation,* and *climate,* are local: changes produced by *disease* and by *luxuriance,* are erratic or uncertain; while changes produced by *culture* are either its consequent and certain, or its erratic and uncertain effects.

Amidst this diversity, we perceive that there are changes which occur in obedience to nature, while others occur in obedience to causes that are of limited or circumscribed influence. Now, though both are alike the natural effects of the causes whence they proceed, yet it is only such as occur in obedience to nature, that is, in obedience to versal external agency, that are to be considered as *natural;* while all that occur in obedience to causes of limited influence, are to be regarded as *incidental.*

Agreeable to this rule or mode of distinction, all changes attendant on *duration,* that is, on *day* and *night,* on *spring, summer, autumn,* and *winter,* and on *youth, maturity,* and

old age, are *natural* changes; while all that proceed from difference of *soil*, *situation*, and *climate*, from *disease*, *culture*, and other causes, are *incidental* changes. The former are natural to every species, and, with the exception of sexual oscillations, are the same in all plants of the same species throughout the world; while the latter are limited and diversified as the causes whence they proceed. A plant may experience a change from *disease*, *soil*, *climate*, and *culture*, or it may not; because it may not be attacked by *disease*,—it may not experience a change of *soil* and *climate*,—nor may it be an object of *culture*. But it is otherwise with respect to the changes attendant on *duration*: for so sure as a plant continues to live, must it experience the same. Thus, *natural changes* are such as must happen independent of a difference in external causes; while *incidental changes* are produced by that difference, and may or may not happen.*

As natural changes are of uniform occurrence, and the same in all plants of the same species, it is rare that they excite surprise, or even attract particular attention. A person who has once ascertained the metamorphosis natural to a species, no longer regards them with astonishment. The change from pinnate to simple leaves, in certain species of *Acacia*, may at first excite surprise; but, like every change that is natural, it soon loses its novelty and becomes familiar. With respect to incidental changes, however, the case is otherwise; for as they proceed from a multiplicity

* If all the changes plants experience are to be distinguished by the very undefined terms—*natural* and *incidental*, then the above is certainly the most unexceptionable sense in which they can be received. Be this as it may, this is the sense in which they are used throughout this work, unless otherwise expressed.

of causes which affect life separately and in conjunction, they are not less remarkable for their diversity, than natural changes are for their uniformity. In short, every specific mark, property, or quality, is liable to incidental changes; and though their duration, in most instances, depends on the presence of that difference in external causes which produced them, yet in some instances they exist independent of the causes of their origin, and are transmitted to posterity by natural generation.

When incidental changes or effects are maintained by the causes that produced them, they are to be distinguished as *Dependent Affections*; but when they exist independent of the causes of their origin, and are transmitted to posterity by natural generation, then are they to be considered as *Specific Distinctions*: for a specific distinction is no other than a distinction which plants, in obedience to nature, transmit to their seminal offspring; and that certain of the secondary or acquired distinctions of plants are of this kind, is a fact which experience and philosophy alike evince. Indeed, it is not more certain that the secondary or acquired distinctions of some plants depend on a difference in extraneous causes, than it is that the acquired distinctions of others depend on an innate or specific difference in the plants themselves.

In distinguishing the acquired distinctions of plants, it may be well to attend to the following particulars:—

If a plant experiences a change from an *exterior cause* or an *association of exterior causes*, and if that change is *consequent*,—by which term I would have the reader understand, if it is the certain or inevitable effects of that *cause*

or *association of causes*,—then is it a *Dependent Affection*; or if it is an *erratic* change, and not the certain or inevitable effects of that cause or association of causes, and if a diseased or a monstrous affection, then is it also a *Dependent Affection*, and depends on causes that are fleeting and unstable. But if the plant is not of intermediate or hybridous origin, and if the change is not of a malific nature, and yet erratic, then may we conclude that it is an acquired *Specific Distinction*.

It is farther worthy of remark, that all the changes plants experience in a state of nature, are either maintained by the causes that produced them, or only enjoy a temporary existence during their absence; and as the *consequent* or certain effects attendant on culture are of the same description, it follows therefrom, that specific distinctions of secondary origin are the *erratic* or uncertain effects of culture.*

There are other particulars which are highly important, and of considerable service in distinguishing the dependent and the specific changes plants experience; yet, as their illustration would lead to a train of inquiries too minute for that of a general survey, it would be improper to particularize them in this place. The reader, however, will be fully apprized of them in the succeeding parts of the work.

Presuming upon the validity of the conclusions to which the preceding investigations have led, we shall now proceed to distinguish and arrange the changes of plants accordingly.

* As specific acquired distinctions are the erratic or uncertain effects of culture, hence culture only acts as an auxiliary cause in producing them, and not as the sole cause of their origin.

Dependent Acquired Distinctions.

Definition.

A dependent acquired distinction is an affection the duration of which depends upon the presence of the causes that produced it.

Specification.

Dependent acquired distinctions are such as plants either naturally or incidentally acquire: hence they belong to two classes—the *natural* and the *incidental.*

Dependent acquired distinctions natural to plants of the same species, are versal, partial, and particular, viz.—such as plants acquire from lapse of time, and are attendant on *day* and *night*,—on *spring*, *summer*, *autumn*, and *winter*,—and on *youth*, *maturity*, and *old age:* such as they acquire from the natural disjunction of the sexes in *diœcious* species: and such as identify individuals.

Dependent acquired distinctions incident to plants of the same species, belong to two divisions, namely,—such as they acquire in *a state of nature*, and such as they acquire in *a state of cultivation.*

Dependent acquired distinctions incident to plants in a state of nature, are of two kinds—the *consequent* and the *erratic.* When of the former denomination, they are the certain effects of soil, climate, and other external causes; and when of the latter, they are the uncertain effects produced by the co-operation of the same causes with others that are adventitious, and which may be either internal or external.

Dependent acquired distinctions peculiar to plants in a state of cultivation, are, like the former, of two kinds—the *consequent* and the *erratic*. When of the former denomination, they are the certain effects of culture; and when of the latter, they are its uncertain effects, produced by its co-operation with adventitious causes that are internal or external, known or unknown.

Agreeable to this arrangement, dependent acquired distinctions are described, in the second part of this volume, under the title of *DEPENDENT AFFECTIONS*.

Specific Acquired Distinctions.

Definition.

A specific acquired distinction is an affection that exists independent of the causes of its origin, and is transmitted to posterity by natural generation: or it is a distinction which, in conjunction with others, constitutes a secondary species.

Specification.

As plants distinguished by specific acquired distinctions are *varieties of their species*, or *species of secondary origin*, they therefore, like original species, differ in *form, proportion, magnitude, colour, taste, smell, duration, fertility*, and *time of flowering*, &c. Yet, as they are ever intimately related to the species from which they have sprung, they may be readily distinguished as their Subspecies or Varieties. Thus *cauliflower* and *brocoli* are subspecies of the *Brassica oleracea*, or cultivated cabbage. It is to be observed, however, that as there exists a very perceptible

difference in the stability of the varieties or subspecies that have sprung from different primary species, they may, in consequence, be conveniently arranged under the three following classes:—

1. A class comprising varieties or secondary species, which, though of the same species, retain their distinctions when growing in proximity, as also the power of transmitting them to posterity by natural generation.

2. A class comprising varieties or secondary species, which, when of the same species, are liable to be deprived of their respective distinctions when growing in proximity.

3. A class comprising varieties or secondary species, the individuals of which, when of the same species, and when growing in proximity, are liable to be deprived of the power of transmitting their respective distinctions to posterity, not only at the time but for ever after.

Agreeable to this arrangement, species of secondary origin are described, in the third part of this volume, under the title of *SUBSPECIES*, or *VARIETIES OF THEIR SPECIES*.

CAUSAL BOTANY.

PART II.

DEPENDENT AFFECTIONS.

CLASS I.

VERSAL CHANGES OR AFFECTIONS NATURAL TO PLANTS, AND ATTENDANT ON DURATION.

The Diurnal Changes of Plants.

THE sleep of plants, the opening and shutting of their flowers, and the emission of their odours at particular or certain hours, may be considered as the most remarkable of the diurnal changes they experience. Yet, although a considerable number afford striking instances of changes of this description, it is not to be understood that they are alike conspicuous in all plants. The different species of *Mimosa*, *Lotus*, *Hedysarum*, and *Trifolium*, furnish remarkable examples of the sleep of plants; and certain species of *Cactus*, *Aster*, *Lactuca*, and *Œnothera*, furnish

instances not less remarkable of the expanding of their flowers at particular hours of the day; while some species, like the *Alsine media*, are remarkable from their being subject to both affections.

Linneus, in treating of the sleep of plants, observes of this *Alsine*, that at night its leaves approach in pairs, so as to inclose, between their upper surfaces, the tender buds; and that the two upper leaves but one, at the end of the shoot, are furnished with longer *petioles* than the terminating pair, so that they can close upon them, and protect the end of the branch. With respect to the expanding and shutting of its flowers, Withering observes that they are open from nine in the morning till noon; but if it rains that they do not open, and that after rain they become pendent, but in a few days rise again. The time, however, that the flowers of this species continue open, depends greatly upon the seasons of the year: for though open during the greater part of the day in summer, they only remain open for a short time in winter. As another and more remarkable instance with respect to the time of flowering, the *Lactuca Virosa* may be mentioned,—the flowers of which open in the morning about eight, and remain open till eleven; but after having been once open, they do not open on the following morning, like those of the *Alsine*, and similar species, but continue shut. But to particularize diurnal changes in different species, would only detain the reader. To some, such inquiries may be highly entertaining; yet it may be presumed, that the most intimate knowledge of diurnal changes can add but little to our stock of useful information. They proceed from causes over which we possess no control, and are occurrences we can neither hasten nor prevent.

The Annual Changes of Plants.

The changes different species of vegetables annually experience, as may be readily conceived, are only repeated in individuals or plants that are perennial: for to such as are of annual duration, the seasons of spring, summer, and autumn, are as the stages of youth, maturity, and old age. The same roots, leaves, and stems, enables the annual to perform its functions during life; but with respect to perennials, the case is otherwise. Some perennials renew their foliage annually,—some renew their foliage and their stalks,—and some not only renew their foliage and their stalks, but their roots also, and thus experience a complete or entire renewal of all their parts.

In general, plants that annually renew their roots multiply by their roots; yet there are some that annually experience a renewal of roots, that seldom or ever experience a multiplication.* Probably in no respect shall we find

* Amongst bulbous plants, the greatest difference exists with respect to their propagating themselves by roots. Nor is this difference limited to primary species, but extends to secondary or subspecies that have sprung from the same original. The florist is well aware of the great difficulty there is in obtaining an increase of certain bulbous plants, and of the facility with which others may be increased. It is by no means uncommon for him to have in his possession a bulb of a tulip or some other species, which bulb he values more than twice its weight in gold, and which he plants year after year, and treats with the greatest care imaginable, using every art in hopes of obtaining an increase, without those hopes being realized under a lapse of five, ten, or even more years; while another variety that has sprung from the same species, yields him annually a greater number of bulbs than he is disposed to cultivate. But notwithstand-

different species of vegetables to differ more, than in their time of growth and manner of increase. Some, like the *horse-chesnut*, only grow during a few weeks in spring: others, like the *hawthorn*, continue growing from the beginning of spring till the end of summer: while others, like the *water-purslane*, never cease growing but when the heat or cold is so intense as wholly to arrest their vital powers. Species of this last description, though perennials, have much the appearance of annuals, and are frequently described as such. Some of them come in flower at certain seasons of the year; while others, at whatever time we may examine them, will be found in flower, coming into flower, and in seed. Of the latter it may be said, that they grow continually, flower as they grow, and put forth roots at every joint; yet their increase, however great, is only commensurate to their decrease.

It may be observed of vegetable species in general, that such as are the natives of warm climates maintain a greater uniformity of appearance throughout the year, than those that are indigenous to cold climates. The former are in general evergreens; while the latter consist principally of deciduous species that are furnished with *hybernacula*, (bulbs, buds, &c.) a provision necessary to defend them from the severity of the winter. As the former consist principally of evergreens, they continue to be clothed in

ing this difficulty in obtaining an increase of plants from certain varieties that have sprung from species that naturally propagate themselves by roots,—a multiplication of the root may, by a particular treatment, be effected in some species, which, if left to nature, would never propagate themselves in that manner. Of this, the *allium cepa*, or common onion, furnishes a remarkable instance.

verdure, while the latter appear in a state of nudity for several months together, with their leaves and flowers, if not their stalks that are to be developed in the course of the ensuing season, inclosed in their *hybernacula*. But even where the greatest uniformity of climate prevails, as in countries within the tropics, few species are to be found that have not their regular seasons of growth and times of bringing forth; and though the annual changes of plants are most conspicuous amongst species that are the natives of cold climates, it cannot be denied that there are likewise some amongst such as are indigenous to warm climates, that annually experience remarkable changes.

Changes attendant on the different Stages of Vegetable Life.

In vegetables and in animals, an imperfectly evolved organization, accompanied by a want of power to perform the functions of *riper years*, are the marks which characterize individuals when in youth: in a state of maturity, a completely evolved organization indicates their power of exercising all the functions which nature has intended them to perform; and in a state of old age, the shrivelling up or mouldering away of their members, proclaims their approaching dissolution.

In general, appearances that indicate the different stages of life, are more conspicuous in vegetables than in animals; because vegetables, with the exception of certain *cryptogamous* species, increase by an accession of parts, and, if perennials, decrease by the partial or gradual diminution of the same. Yet, between the changes the different species of animals experience, the diversity is probably as

great, if not greater, than amongst vegetables; for although some species of vegetables experience changes that are very different to the changes the generality experience, yet species of this description are far from being numerous.

Plants that are subject to remarkable changes in their roots or foliage, when in their early stages, never undergo the like changes a second time. The seedling wears its own dress—that of youth, until age has produced an evolvement in its organization, and conferred upon it the marks that indicate maturity, which marks must, in their turn, give place to those that indicate old age and decay. Such is the course of nature: nor is it in art to divert her wholly from that course, though means may be employed by which the affections peculiar to certain stages may be either delayed or hastened.

Thus the aged holly, the leaves of which have lost their armature, may be transmitted to posterity in that state, by means of artificial propagation; and, by the like means, may the aged ivy, the extremities of which have assumed a compact bushy form, attired with heart-shaped leaves. For although the insertion of the buds or scions of an aged holly upon a young holly, imparts health and vigour, it does not impart the characteristics of youth to those scions, or restore to them their lost armature; and though the planting of the stunted extremities of an aged ivy by the side of a wall, may induce them to become vigorous, it never will induce them to climb. Plants, therefore, that have attained an old age, and that have assumed the characteristics peculiar to that state, must continue in that state during the remainder of their lives: nor they alone, but all that are propagated from them by division or exten-

sion,—for though art may succeed in maintaining the latter in a state of health, no art will ever induce them to assume that habit or attire which characterizes the young seedling plants of their species.

The change produced in the buds or scions of young plants, by inserting them upon mature or old plants, is very different to that which we have just noticed. These, when inserted upon plants that have attained maturity, soon acquire the powers peculiar to that state; and, when inserted upon old plants, they as speedily acquire the characteristics, and consequently the infirmities attendant on old age. Thus, by innoculation, the young may experience an almost instantaneous transition from a state of youth to that of old age; while the aged, under all the health and vigour that youth can impart, continue to retain their distinctions. Great allowance must nevertheless be made for the difference that exists between species. The majority, when in their different stages of existence, experience no remarkable change in either their roots, foliage, or armature; and though it is difficult to propagate some by extension, the very leaves of others, if they drop upon the ground, strike root and produce young plants. Hence it is evident, that no remarks respecting the changes that are effected in plants by artificial propagation, can be alike applicable to all.

As the principal object of this work is to illustrate the causes and character of the secondary distinctions of plants, rather than describe their primary distinctions, and the appearances which they, in obedience to nature, must necessarily assume,—the preceding survey of the changes

they naturally experience, is therefore brief, and limited solely to such as are *versal*, or the same in all plants of the same species. Of their natural distinctions that are *individual*, a particular description is impracticable; whilst of those which are *partial*, it may be observed that our knowledge is extremely limited; and the principal facts respecting them are noticed either in the preceding or subsequent parts of the work.

DEPENDENT AFFECTIONS.

CLASS II.

DEPENDENT AFFECTIONS INCIDENT TO PLANTS IN A STATE OF NATURE.

Dependent Consequent Affections incident to Plants in a state of nature, or such as difference in soil, situation, climate, and other obvious causes, must produce.

THOUGH the majority of vegetables have particular soils, situations, and climates, assigned them by nature, yet some are widely diffused, and differ greatly in form and appearance, by reason of a difference in the soils, situations, and climates they inhabit. There are even instances of the difference so produced in individuals of the same species, being such as to induce inexperienced observers to conclude that they are specifically distinct. But however great or remarkable may be the distinctions produced in plants, by difference of soil, situation, and climate, experience testifies that all such distinctions depend upon the causes of their origin; for when plants so distinguished are brought together, and planted in the same soil, situation, and climate, if they are really of the same species, all distinctions foreign to the soil, situation, and climate in which they are planted, either experience an immediate reduction, or are no longer such as the plants can transmit to their seminal offspring. As numbers of plants, however, retain during their life-

time the affections peculiar to the soils, situations, and climates in which they have been raised from seed, and as numbers propagate themselves by extension, we therefore find plants, which, by their longevity and regular reproduction of roots and suckers, are enabled to transmit to the most distant periods, affections that are foreign to the soils, situations, and climates into which they have been introduced, though no longer capable of transmitting the same to their seminal offspring.

The effect of soil, situation, and climate, upon the seeds of plants, is similar in every respect to that produced in the plants themselves. From seed the produce of distant countries, and of different soils and situations, we in general obtain plants that retain the affections peculiar to the country, the soil, and the situation, in which that seed was produced; yet, like plants that have been imported from distant countries, or that have experienced a change of soil and situation, they fail to transmit the same to their seminal offspring. But though plants that are the produce of different soils, situations, and climates, or that have been obtained from seed the produce of such, are in general found to retain the affections peculiar to the said soils, situations, and climates, even when removed to such as are widely different,—it cannot be denied that their removal from one situation to another, is sometimes the cause of immediate changes in their appearance. Mr. Bradley relates a very remarkable instance of this in the *Anemone Hepatica*. It is as follows:—Some roots of the double blue hepatica were sent to Mr. Harrison of Henley upon Thames, from the garden of Mr. Keys in Tothill-fields, whose soil was so different from that in which they were planted at Henley, that when they came to blossom there,

they produced white flowers; they were therefore returned back to their former station, where they resumed the blue colour they had at first. Similar instances are recorded by other authors; nor can a doubt exist of a difference in soil, situation, and climate, having the power of producing and reducing certain distinctions in plants, independent of seminal propagation. Yet experience shows that this seldom takes place.

The most variable affections vegetables experience from a difference of soil, situation, and climate, are evidently such as indicate the state or degree of health they enjoy; while the more stable, enable them to enjoy the like good health under a variety of local circumstances. It is farther worthy of remark, that the greater the diversity of soils, situations, and climates, in which plants are enabled to live and enjoy good health, the more numerous and remarkable are the changes they experience; whilst the more limited their powers of adapting themselves to local differences, the fewer and less remarkable are their changes. Hence, as some are endued with wonderful powers of adapting themselves to the circumstances under which they may be designedly or accidentally placed, while others have particular soils, situations, and climates assigned them, out of which they cannot possibly live,—there are some, therefore, that experience very remarkable changes, and some that never experience any other than such as evince a good or a bad state of health.

The following are a few instances of some remarkable changes which certain well-known plants experience from a difference of soil, situation, and climate:—

The leaves of the *Ranunculus aquatilis*, or water-ranun-

culus, when produced under water, are compound and capillary; but when produced out of water, they are simple, with nearly central leaf-stalks.

The *Phleum pratense* produces fibrous roots when growing in watery soils, but in dry or arid soils it produces bulbous roots.

The *Polygonum amphibium*, when growing in water, flowers freely and produces abundance of seed; but when on land it never flowers: yet, when on land, it readily propagates itself by extension, and in some parts of Britain proves to the cultivator a most troublesome weed.

The *Triticum compositum*, or Egyptian wheat, when cultivated in Britain, has its compound spike transformed into one that is simple, and thus loses that characteristic from which it derives its name.

The potatoe-oats from the northern parts of Britain, when cultivated in Surrey, Kent, and the more southern counties, only retain for one season that fertility for which they are remarkable.

The Gooseberry, at New York, is barren, or nearly so; and in countries where the winters are mild, and the atmosphere humid, it becomes an evergreen.

The *Phaseolus multiflorus*, or scarlet-runner, though a perennial species, is generally considered as an annual in this country,—the severity of our winters killing it.

In the West Indies, the flowers of the *Alsine media*, or

common chick weed, are invariably found with three *stamens*; but in countries that do not enjoy the like uniform temperature, its flowers are found with from three to ten *stamens.*

In addition, many remarkable instances might be mentioned of the changes that are produced in plants by difference of soil, situation and climate; indeed, a difference in climate alone, is such as to cause a difference in plants of the same species at every degree of latitude, and at every thousand feet of altitude; nor does their difference in appearance cease to encrease, but encreases as we advance in either direction, until we arrive at the farthest habitable stations assigned them. Some, as certain species of *Poa, Festuca, Polygonum,* and *Allium*, flower and produce abundance of seed when in low and warm situations, but when in elevated and cold situations they neither flower nor produce seed, but become viviparous; and in the latter stations, some that are naturally dwarf, become prostrate, while others that are tall become pendent.* But, however varied or remarkable the forms may be which they assume, the same when general, that is, when common unto all plants of the same species in the same station, are evidently such as adapt them to the climates and situations they inhabit. Did not the plants that are viviparous in mountainous situations become so, it is very obvious that

* Prostration in the branches of dwarf growing species and pendulosity in the branches of such as are naturally of tall growth, is certainly one and the same affection; and though from many instances it could be shown, that this affection prevails most in elevated and in cold situations, yet upon enquiry it will be found, that it is not peculiar unto any soil, situation, or climate. The probability is, that this affection concerning which so very little is known, is no other than a sexual variance; its being confined unto *Dioecious* and *Monoecious* species, is a circumstance that leaves little doubt of its being such.

there they would cease to exist; because, in elevated situations the frost and snow sets in early, and continues so long, that there is not sufficient time for them to flower and bring their seeds to perfection.

One of the most important circumstances repecting affections produced by difference of soil, situation, and climate, is, that in most instances they may be transferred from one station unto another by means of seed. This is a subject that merits the attention not only of every cultivator, but of every patriot or friend to his country; for by transferring those affections, soils and situations that are naturally sterile, may oftentimes be made to yield the necessaries of life in abundance.

The naturalization of different species of vegetables is another subject that presents itself for our consideration; to effect this, the first thing to be attended unto, is to obtain plants from the seed of such as have been introduced or that have been raised from foreign seed, which being done, the object so far as practicable, may be considered as attained; for it is not necessary that imported plants, or plants obtained from imported seed, should be repeatedly produced from home-grown seed in order to naturalize them, their first or second renewal being all that is required to reduce their foreign distinctions, and impart such as are peculiar to the country into which they have been imported.

As the simple effects of every external cause by which plants in their natural state are changed, are such as belong to this Class and Division of Affections, the Reader will readily perceive, that those of wounds, bruises, and the like accidents, are of the numbre. Of these how-

ever, it is unnecessary here to treat; for as they are simply injuries, which neither the growth of the plants nor their seminal encrease can propagate or multiply, to describe them would only be to lengthen this enquiry without exhibiting any thing that merits particular attention.

Dependent Erratic Affections incident to Plants in a state of nature, or such as may or may not be produced by the same external power.

Affections of this description consist principally if not solely of diseases, and luxuriances: but as the latter are in a great measure confined unto cultivated plants, they are therefore treated of under that subdivision wherein Erratic Affections incident to plants in a state of cultivation are described; while the present enquiry is limited solely unto affections that proceed from disease.

Of affections produced by disease, some vanish upon the return of the plants to a state of health, while others frequently continue to distinguish them so long as they live: *variegation, floral changes in colour, crispation* and *canker*, are of the latter description, and are such as merit particular enquiry.

Variegation.—This affection, when a disease, is commonly confined unto the leaves of plants, though there may be instances of its extending unto the flowers likewise: it occurs in all stages of their existence; in some instances it accompanies them from seed, and is then most fixed or permanent; in others it is confined to a

branch, and in others it pervades the plant, and even extends to contiguous plants of the same kind. It is sometimes communicated unto plain plants by inoculation; and though instances of its being communicated in this manner are rare, yet in the jasmine, privet, and ash, the insertion of a variegated bud or scion upon a plain plant has repeatedly been known to have the effect.

The origin or causes of variegation are involved in the like obscurity as the causes of the greater number of distempers: we know of no particular cause or means that will invariably produce variegation; yet we know of causes, that occasionally produce, or rather, contribute to produce it. The wounding or injuring of plants in any way, may induce variegation, as is manifest from the twigs or branches that become variegated, being in most instances, bruised, broken, or otherwise injured prior to that change.

Variegation, as every person well knows, differs greatly in different species; the foliage of some being striped, while that of others is mottled or blotched; but this difference evidently arises from a difference in the plants and not in the distemper which affects them; for upon examining the leaves of the former, we shall find them to be composed of longitudinal fibres like those of the *Yucca* and *Iris*, while the leaves of the latter are composed of reticulated fibres like those of the *sycamore* and *elder*.

It is rare that the seeds of variegated plants produce others that are variegated; yet instances have been known, of their seeds producing such for several years in succession. Miller, in treating of the variegated sycamore, gives us to

understand, that variegated plants may be obtained from its seeds without fail; but this is not the case, and though it cannot be denied that its seeds oftentimes produce such, yet there is no reason to believe, that it differs from other species in this particular. The fact is, variegated plants may at one time, be obtained from the seeds of such as are variegated, and not at another; and the insertion of variegated scions or buds may impart variegation at one time, and not at another; because, plants though variegated, are not at all times the seat of that disease which causes variegation, and it is only when they are in a state of active disease, that the affection is propagated either by seminal encrease or inoculation.

There is certainly no reason whatever to believe, that variegated plants are diseased, when the variegation is no longer propagated by their proximity unto other plants,—by the insertion of their buds, nor by their renewal from seed. But a more satisfactory proof of the majority of such plants being free from disease, we cannot possibly have than that of the health they commonly enjoy.—Health and disease never can associate,—every disease is prejudicial to health and mortal in its tendency, and would prove mortal in effect were it not counteracted by the inherent energies of life*.

"All suffering doth destroy, or is destroyed,
Even by the sufferer."

* A disease seldom remains in the same state, but either increases and kills, terminates in another distemper, or produces some action or motion in the body, by which it is cured.

FORDYCE's *Practice of Physic*, p. 130.

there is no reason to believe that they are decidedly hostile to the health of plants. A mere change in colour to beings, some of which can scarcely be said to have any fixed or determinate colour assigned them, can be no great misfortune; and though the same may frequently proceed from causes that are highly prejudicial to health, it is not to be supposed that they invariably proceed from such: on the contrary, we know that changes in the colour of the flowers of plants are affected by various causes. Thus, in the northern parts of Britain it is rare we find the *Lychnis dioica* with white flowers; while in the southern parts, white flowering plants of that species, are almost as plentiful as the red, and in in chalky soils, scarcely any other are to be found.—Throughout the whole of North Britain, the flowers of the *Gymnadenia Conopsea*, are dark purple; while upon the chalk hills of Surry and Kent, they are flesh coloured.—In every soil. situation, and climate, of which the *Polygala vulgaris* is an inhabitant, it is found with blue, flesh-coloured, and white flowers, so that it is oftentimes impossible to say, whether the plants producing the blue, flesh-coloured, or white flowers most abound.—Along the coast immediately to the westward of Edinburgh, the *Glaux maritima*, is found with white flowers, while all along the opposite coast its flowers are flesh-coloured; yet the soil and situation of both stations are exactly alike.

In the instance of the *Lychnis*, the change in colour, though not strictly depending upon a difference in soil and climate, appears to be greatly influenced by that difference: in the *Gymnadenia*, it appears to be strictly depending: in the *Polygala*, we have an instance, of a species, that may be said to have no fixed or determinate colour; and in the *Glaux*, we have an instance of the stability of a secondary distinction, though founded upon no visible specific diffe-

rence nor maintained by any known difference in exterior causes. Thus, some species furnish instances of floral changes in colour that proceed solely from a difference in local circumstances: others, of such as partly proceed from that difference; and others of such as occur independent of the same. Upon the whole, changes in the colour of the flowers of plants, are in some instances specific, and in others they depend on soil, situation, climate, disease, culture, and other causes; while it is to be observed, that though they may be the same, yet they may be the effects of causes that are not only different but opposite. Indeed, instances of causes that are diametrically opposite producing the same effects in plants of the same species are by no means infrequent. The heat of the West Indies, as already observed, reduces the *stamens* of the *Alsine media* or commmon chick-weed to three, and in Britain, our cold winters reduce them to the same number.*

Linneus, in treating of floral changes in colour, observes, that in general, they are from blue to red, from blue to white, and from red to white, and not from white to red or blue. The truth of this remark is sufficiently con-

* Of this very troublesome and well known weed, it may be observed, that it is an inhabitant of every soil, situation and climate, if not of every kingdom, province, and garden, in the known world. It is generally described as producing flowers with five *stamens*, but Swartz informs us, that in the West Indies its flowers are invariably found with three stamens; and I am perfectly satisfied from personal observation, that in Britain, though generally found with five, during spring, summer, and autumn, that their number is reduced to three in winter. As the heat of the former station therefore, and the cold of the latter at the above-mentioned season, reduces the *stamens* of this species to the same number, it plainly shows, that by causes that are not only different but opposite, the same effects are sometimes produced.

firmed by experience: indeed, instances to the contrary amongst plants in a state of nature are rare if not unknown; and though plants in a state of cultivation, sometimes experience changes from a light to a dark colour, yet it is rare that they experience such. Now, as changes from a light to a dark colour are confined to cultivated plants, it is evident, that species with white flowers are exempt from changes in colour when in a state of nature: and it may be presumed, when species with red, purple, or blue flowers, experience a change by which they produce white flowers, that the colour of their flowers are in that case such as they will not readily exchange even though external causes should not be the most favorable to their continuing in that state. This in some measure accounts for plants that have lost the colour of their flowers, continuing not only to produce colourless or white flowers, but for their occasionally transmitting the affection to their seminal offspring in the absence of the causes whence it proceeds.

It has been observed, that the distinguishing characteristic of Dependent Affections, is, that they do not admit of seminal renewal in the absence of the causes that produce them; but though they cease to exist in the absence of the causes of their origin; yet it is rare that their reduction is immediate. On the contrary, it is common for them to continue during the existence of the plants affected; and though the plants can no longer transmit them in a regular manner to posterity, yet it sometimes happens that they transmit them, and this more frequently happens when the affection is such as may constitute a specific difference by its union with other distinctions.

Crispation or curl in the foliage of Plants.—Though

this is known as a diseased affection, it is only in some few species that is known as such: in the *Pteris crispa*, it is an original or primary distinction, and serves to characterize that species from others of the genus; in the *Lactuca sativa*, it is a secondary distinction, and serves to characterize certain varieties of that species; in the *Fraxinus excelsior* or common ash, it appears as a monstrous affection; and in the *Solanum tuberosum* or potatoe, it is well-known as a most virulent distemper. Thus, curl in the leaves of plants, when secondary, is in some cases the effect of disease and in others of luxuriance: when it proceeds from disease the leaves are less than when plain, but when it proceeds from luxuriance they are larger. A diseased crispation by contracting the leaf and depriving it of its juices, lessens its dimensions; while a luxuriant crispation, by the preternatural encrease of its medullary or less rigid parts, adds greatly to its size. This difference is very obvious upon inspection, and by it we are enabled to distinguish diseased from luxuriant crispations with facility.

It is observed by Linneus and other Botanists, that when the leaves of odoriferous plants become curled, that they are rendered more fragrant by the change; but this only holds good in crispations that proceed from luxuriance, and not in such as are the effects of disease; for a diseased crispation, has a direct tendency to deprive plants of every quality or property, that can enhance their value or recommend them to notice.

Probably, no species of vegetable is more frequently attacked, or more severely injured by a diseased crispation, than the *Solanum tuberosum* or potatoe; and were it not that means have been discovered by which its ravages are

in some measure prevented, in many parts of this Island, this most usefel plant, would cease to be an object of culture. But as it only prevails in certain districts, the cultivator by procuring his *seed potatoes* every second or third year from some part of the country where it is unknown, succeeds in eluding it, and in raising crops that may vie with such as are the produce of more favorable situations.

Some attribute this disease in the potatoe to an over-ripeness of tubers, and recommend the digging of them up in an unripe state as a preventive; but there exists good reasons for asserting, that curl in this species proceeds from other causes. Indeed, it cannot be supposed, that a ripeness in the roots of a plant is a cause of curl or of any other disease in this, or in any other species, without admitting that the laws of nature are inimical to the health and increase of plants. But admitting an over-ripeness of tubers to be the cause, then would early varieties of the potatoe suffer more from curl than the late, because it is the common practice to allow varieties of that description to get perfectly ripe before they are taken up. The fact however is, early varieties of the potatoe are either wholly exempt or but seldom subject to a curl,—a fact, which seems to have escaped the observation of those, who in treating of that distemper in the potatoe, have erred in supposing it to proceed from an over-ripeness of tubers.*

That curl in the potatoe proceeds from various causes that operate in conjunction, and not from any one cause,

* In no soil or situation have I ever known an early variety of the potatoe to be attacked by curl; nor have I observed any to be attacked by that distemper that were not decidedly late. I might refer unto many instances of early varieties being free from curl when growing in.

is obvious: we know that its ravages are limited to certain soils and situations; that in the same soil and situation it is more prevalent at one time than at another; that early varieties are exempt from its attacks; and that late varieties are seldom attacked when planted early in spring and taken up sooner than usual in autumn. The practice to be observed therefore, is to plant early, and take up as soon as the crop has come to perfection; to make choice of varieties that are early or at least earlier than the generality of varieties that are distinguished as late; and to change the seed as often as convenience may offer or need require.

The digging up of potatoes sooner than usual is generally allowed to be a means of preventing curl, and the digging of them up in an unripe state has been strongly recommended by some, not only as a means of preventing curl, but as a means by which the quality of the potatoes may be greatly improved. Potatoes treated in this manner are said to be less coarse, and to vegetate much sooner when replanted. It may be presumed however, that the practice has little to recommend it: good varieties do not require such treatment, and though coarse varieties may be sometimes improved by it, the probability is, that in the end they will be rendered much worse. Temporary advantages are oftentimes obtained from modes of treatment, which ultimately prove most baneful. Thus, by

situations, in which the late suffer greatly from its attacks, but as the following sufficiently evinces the fact, it may suffice.

In the garden of that Nobleman to whom this work is dedicated, no late variety of the potatoe proves free from curl for a longer period than three years; yet in that garden, an early variety has been in constant cultivation for these last fifty years, and is still free from that distemper

pruning vines twice, two crops of grapes may be obtained in immediate succession or nearly at the same time: by topping the shoots of the fig, two or three crops may be obtained; and by digging up tulip bulbs before they are perfectly ripened, which is a parallel instance to that of the potatoe, the said bulbs will on the following season produce flowers finer in colour. But he who gathers annually two crops of grapes from the same plants, will soon find himself without grapes; and he who is not satisfied with a crop of figs in spring, and another in autumn, but must have a third, will find at last, that his three crops are not equal to one moderate crop; and the tulip fancier, whose green or unripe bulbs has enabled him to carry off the prize, must not expect to carry off another by persisting in the same mode of treatment with the same bulbs.

The injurious consequences of adopting as general rules of practice, methods which should not be practised but upon certain occasions and then with caution, are but too apparent. Some people when they have ascertained that immediate advantages may be gained by divesting plants of their roots, by depriving them of portions of their bark, and the like outrages, are not satisfied until they have made it their general practice. They do not reflect, that though vigorous plants are endowed with the power of repairing certain injuries in a manner that may prove advantageous to their owner, that the same is effected at the immediate expence of vigour, if not of health, and that the practice when carried to an extreme, or when persisted in, must terminate in the destruction of the plants.

Canker.—This distemper, though incident to the greater number of species, more frequently happens unto

the ligneous; its attacks are principally confined to the axilla of the branches and roots, and like other distempers, the extent of its ravages depend greatly upon soil, situation, and climate,. The apple is very subject to this disease; yet all its varieties are not alike subject, nor are plants of the same variety alike subject when differently propagated. Plants raised from seed are the most exempt; and from the evidence of some experienced cultivators, it would appear that plants propagated from layers and cuttings, are more exempt than such as are propagated from buds and scions.

The principal cause of canker appears to be an unfavorable soil; by some however, it is supposed to proceed principally if not solely from injuries inflicted by predaceous insects; but there is no just grounds for supposing that the wounds inflicted by insects is either the principal or sole cause, though it is probable that the same may frequently act as an auxiliary cause, not only in producing canker, but in producing almost every disease unto which plants are liable. The injuries plants experience from insects are probably more numerous than from all the other ills that beset them, yet it may be presumed, that the injuries so produced, seldom or ever generate diseases properly so called, unless when they operate in conjunction with other malific causes.*

In order to arrest the progress of canker in trees, it is recommended to cut out the parts affected, and to trench

* It is customary to distinguish plants when injured by insects as diseased plants; but this, though customary, is improper. To contend that a plant dies of disease, when killed by its enemies the thrips, is as absurd as to contend that the warrior who falls in the field of battle dies of a distemper.

and otherwise improve the soil; and there are some who recommend certain topical applications, but the efficacy of these notwithstanding the high estimation in which they have been held, appears to depend more upon the means used prior to applying them, than upon any healing or reparative properties they possess.

Blights.—A blight in vegetables may be compared to a sickness in animals; the term in its general acceptation, is used to denote appearances, without particularizing them in any other way than that they evince an injured or bad state of health. Thus, plants are said to be blighted when injured by green-fly, mildew, smut, spur, rust and the like; and they are known by the same appellation when their leaves fall-off, wither or decay, by reason of inclemency and other causes. It is to this last mentioned denomination of blights I would call the attention of the reader; indeed a description of the former would only prove a description of insects and minute parasitical fungi—of the wounds they inflict—of the weakness, havock, and destruction they occasion, and not of any disease in the plants themselves.

Miller, in treating of the Peach, observes, that the blights of which it is now proposed to treat "do not so much proceed from any external cause, or inclemency of the season, as from a distemper or weakness in the trees; for if we observe the trees at that season (spring) when they are most subject to what is called a blight, we shall find the branches very small, weak, and not half ripened, as also trained in very close to each other; these branches are, for the most part full of blossom-buds, which is chiefly occasioned by their want of strength. These buds do indeed open, and to persons not skilled in fruit-trees, shew

a great prospect of a plentiful crop of fruit; whereas the whole strength of the branches is spent in nourishing the flowers, and being unable to do any more, the blossoms fall off, and the small efforts of the leaf-buds are checked, so that many times a great part of the branches die away, and this is called a great blight; whereas, at the same time it may be often observed, that some trees of a different sort, nay of the same sort, were stronger and in health though placed in the same soil, exposed to the same aspect, and subject to the same inclemency of air, have escaped very well, when the weak trees have appeared to be almost dead; which is a plain indication, that it proceeds from some cause within the tree, and not from any external blight." This author then proceeds to give directions concerning the management of such trees, all which are intended to induce vigour, the only thing, which trees in that state require; for their blight is merely a want of strength, an imbecility that may have arisen from various causes;—it may have been caused by their roots being buried too deep in the soil; or by their being planted in a soil that does not afford sufficient or proper nourishment; or as Miller observes, it may have arisen from improper pruning, and from too much wood having been left upon them. But in asserting that such is the case, it should be recollected, that trees, when in a soil, situation, and climate that is suitable, do not require the aid of man to maintain them in a state of health, nor regular pruning to enable them to produce fruit. An apple-tree, when planted in a proper soil and situation, will continue to yield abundant crops of fruit for a period of fifty or sixty years, and during that time it will not require one half the attention that a peach-tree requires during one season; it may be said to produce

abundant crops of fruit, though no attention whatever is paid it; while the peach requires constant attention, which if it do not receive, it not only ceases to produce fruit, but to live; yet the peach in the United States of America, and other parts of the world more genial to its growth, requires no more labour or care, than the apple with us. It is evident therefore, that inclemency is the principal cause of all that labour, care, and attention, which it requires when cultivated in this country;—it is the cause why pruning is so necessary, and why the least error in pruning, planting, thinning, or indeed in any thing that is calculated to affect life, either terminates in producing weakness or distemper.

In Britain, we have but few cultivated plants that are indigenous; by far the greater number are the natives of warmer regions; and many of them evidently require longer summers, and more mild autumns than we are favored with, to enable them to bring their fruits to perfection.* That species of this description should frequently fall a prey to distempers, in defiance of the means used to maintain them in a state of health, need not surprize us: the same species in climates less genial would suffer still more, while the exertions of the cultivator, in order to obtain a crop, must needs be redoubled; for the greater the local disadvantages a plant has to contend with are, the more sub-

* Early varieties of grain and pulse appear to be peculiarly adapted to the climate of Britain, and when they can be obtained equal in quality and productiveness to the late, no doubt can exist of their decided superiority. By their being early they arrive at greater perfection: they are not so liable to distempers: they allow the cultivator more time to improve and prepare the soil; and as they occupy it a less time, we may conclude, that they do not exhaust it so much.

ject will it be to distempers, and the greater must be the exertions of the cultivator to remedy the disadvantages and avert the maladies that proceed from them. It is to be observed however, that though he may, by judicious treatment, avoid numerous maladies, yet there are others against which he does not even possess a means of defence; and to assert that his methods of treatment is the cause of such, or that he is chargeable with the injuries or deaths they may occasion, is certainly most unjust;—it reminds one of the Chinese law, by which physicians are tried as the murderers of the patients that die under their prescriptions.

From the preceding statements, it is sufficiently obvious, that the causes of diseases in plants are numerous, while the diseases they experience are comparatively few; it must be therefore, that various causes frequently combine to produce the same distempers. Some may trace curl, canker, and the other maladies herein described, to inclemency, and some may trace them to improper treatment: but the fact is, none of those maladies are the concomitant or attendant, the necessary or inevitable effects of the causes they allege; nor is their any reason to believe, that they are the certain or inevitable effects of any external cause or association of external causes whatever. By cutting off a branch from a succulent plant and exposing it to the rays of a scorching sun, we may induce a disease in that branch that shall cause variegation; yet, as a thousand branches may be treated in this manner without producing that affection, the same is a proof that the means employed is not of itself an efficient cause of variegntion, but only a remote cause, *quae sola non sufficit, sed intercedentem aliam requirit causam propriorem, ut morbus fiat.*

That diseases of every denomination are brought on by external causes, is an unquestionable fact; yet, it is not to be inferred from this, that they are the direct or simple effects of the same; for in this world of cause and effect, every external cause by which the appearance of living creatures are or may be changed, produces different effects by its differing in degree, by it acting in conjunction with other external causes, and frequently by its repetition or recurrence. In short, the effects of causes that are external become internal causes, so that their manner of operation is infinitely diversified; and it is obvious, that their effects would be equally diversified, were life a principle as incapable of resistance, as it is susceptible of impulse; but as it is ever exerted to resist aggression, and to effect the reduction of all that is inimical to itself, it is impossible that diseases should be any other than of circumscribed occurrence, and of transient duration when produced.

Though these remarks are applicable to diseases in general, it cannot be denied, that plants and animals likewise, occasionally experience diseases that are the necessary or certain effects of particular causes. Thus, when insects deposit their ova or larvæ in the leaves of the oak, the diseased excrescences sold in shops under the the name of galls are produced: when they deposit the same in the stems of the thistle, gibbosity is the result; and when in the roots of the cabbage, it is the cause of what cultivators term clubbing. Farther, in an Island near Iceland, where vegetables are not to be got, we are informed, that the quality of woman's milk is so materially injured by the use, of dried flesh, that the children invariably die of tetanus

before they are three weeks old, and that the population is supplied from the mainland.* These, and other instances show, that the distempers of plants and animals, are not wholly the erratic or uncertain effects of exterior causes, but in some cases their certain and inevitable effects.

DEPENDENT AFFECTIONS PECULIAR TO PLANTS IN A STATE OF CULTIVATION.

Dependent Consequent Affections peculiar to plants in a state of cultivation, or such as culture must produce.

Of the consequent effects of culture, or of the affections which culture must produce, it is to be observed, that they differ in different species, and in the same species, when different modes of treatment are practised: that in some, they are conspicuous and in others minute; while in all, they are such as enhance the value of plants by the improvement of their esteemed properties or qualities. To produce them, is the object of culture, and when produced, they constitute its reward. The means resorted to, in order to produce them, comprise all the arts employed by cultivators, the principal of which, is that designated the cultivation or improvement of the soil; indeed, many species when in situations and climates that are in every respect favorable, appear to require nothing more than the cultivation of the soil to enable them to arrive at the greatest

* Sir George Makenzie's *History of Iceland.*

perfection; but when in soils, situations, and climates that are unfavorable, their wants are multiplied, and the labour of the cultivator encreased.

From this last mentioned circumstance, it is evident, that culture, in a great measure, consists in making amends for the defects of soil, situation, and climate; yet, it must not be supposed, that the attention of cultivators is solely directed to the correcting of those defects; nor is it to be supposed, that no improvement can take place different to that produced by genial soils, situations, and climates. On the contrary, it will be found upon enquiry, that though the fertility or improvement effected in some species by culture, does not far, if at all, surpass that effected by a genial soil, situation, and climate; yet, in others, it is evidently such, as no soil, situation, or climate, however genial can produce. Of this super-added or more than natural productiveness it is to be observed, that the same is strictly in proportion to the labour and attention different species require to bring them to perfection when growing in soils, situations, and climates, that are in every respect favorable; and it is further worthy of remark, that this fertility differs from that produced naturally, not only in degree, but in kind, and that the greater it is in any species, the greater deterioration will that species experience when its culture is neglected. But in order that the particulars now stated, may be fully confirmed, and perfectly understood, we shall proceed to investigate the subject more minutely.

That amongst cultivated plants, there are some that derive their principal excellence from the soil, situation, and climate in which they are cultivated, while others

derive it from the treatment they experience, is a fact which the practice of cultivators plainly evince. Thus, they who grow vegetables on a large scale for the London market, make it a rule to save annually the seeds of radishes, lettuces, leeks, beets, and the like: that seed they will not exchange for other seed of the same species, variety, or sort; nor will they use any other, until they have ascertained it to be the produce of plants that have been properly treated. But how different it is with respect to the seeds of some other species? How readily the farmer exchanges his oats, wheat, and barley, for that which is the produce of a different part of the country, and more particularly when he knows it to be the produce of a district that is favorable to the growth of grain. Now, the reason of this is obvious: the former description of plants, derive their superior fertility from culture; while the latter, derive it from the soil, situation, and climate in which they are cultivated.

Of cultivated plants, none derive a greater fertility from culture than culinary vegetables, and none suffer a greater deterioration when their culture is neglected; for when left to themselves in the richest soils and most favorable situations, they are scarcely any longer to be known as the same. An instance of this species of deterioration, and of a very general mistake it gives rise to, is taken notice of by Miller, who in treating of the *Allium porrum* or leek, observes.—"Of the leek there has been generally supposed two sorts, but I have made trial of them both, by saving the seeds several times, and find they are the same; the difference which has risen between them, has been occasioned by some persons having saved the seeds from

old roots, and not from the seedling leeks, whereby they have degenerated them, and rendered them smaller and narrower leaved; but by care this may be recovered again, as I have experienced." It does not appear however, that the deterioration produced in this species by improper culture, is greater than that produced by a neglect of, or by improper culture in the other cultivated species of *Allium*; nor does it appear to be greater in the species and varieties of that genus, than in the cultivated species and varieties of *Brassica*, *Lactuca*, *Raphanus*, and other culinary vegetables, which like the *Allium porrum* or leek, are apt to be considered, as consisting of a greater number of varieties than they really consist of, when their seeds happen to be saved from plants, that have either partly, or wholly lost, that more than natural vigour and productiveness they acquire from cultivation.

That much depends upon soil, situation, and climate, in bringing culinary vegetables to perfection, will readily be allowed; yet, it is very evident, that their principal excellence depends upon the treatment they experience at the hand of the cultivator. In saving their seeds, he selects the best plants, and plants them at regular distances, in the richest soil, and most favorable situation he can find; in short, he uses every possible means to induce vigour and luxuriance, well knowing, that by a different mode of treatment, bad seed will be produced, which under the ablest cultivators, in the richest soil, and most favorable situation, will yield but a very inferior crop. But in saving the seeds of graniferous and pulse-bearing plants, none of this labour and nicety is required; so far indeed, is this from being the case, that we frequently find their

seeds to be very good, though produced by plants that have had their culture wholly neglected; nor are instances wanting, of the most inferior seed that is produced by graniferous plants, even by them when in a diseased state, being used as seed-corn with success.*

The labour and attention, the different species and subspecies of grain and pulse require from the cultivator, is trivial when compared with that required by culinary vegetables; indeed, where the soil, situation, and climate is in every respect favorable, nothing can be more simple that the treatment of the former. Thus, in Egypt a country celebrated in all ages for the superior quality of its grain, the cultivator obtains his crops with the least possible labour—upon the sediment left by the annual inundation of the Nile, he sows the seeds of grain and pulse, and harrows them in:—to do less in order to obtain a crop he cannot, and to do more is not required. But in culinary vegetables, the fertile soil and genial climate of the Delta,

* The late Sir Joseph Banks, in treating of blighted and defective corn, recommends it to be used as seed corn, observing that the use of the flour of corn in furthering the process of vegetation, is to nourish the minute plant from the time of its development till its roots are able to attract food from the manured earth; and that for this purpose one tenth of the contents of a grain of good wheat is more than sufficient. The practice of purchasing for seed corn the boldest and plumpest samples that can be obtained, he condemns as an unnecessary waste of human subsistence, observing, that "the smallest grains, or such as are sifted out before the wheat is carried to market, and either consumed in the Farmer's family, or given to his poultry, will be found by experience to answer the purpose of propagating the sort from whence they sprung, as effectually as the largest."

would but ill supply the place of culture; because, they do not derive their superior productiveness from soil, nor from climate, but from culture:—their excellence consists in a productiveness that requires the labour and attention of years to produce it, and which, if lost, the like labour and attention must be exerted in order to regain it.

We are apt to conclude, that if the labour and skill employed in some countries in raising crops, were employed in countries more genial, that the produce would be augmented and improved in proportion. This however cannot apply to cultivated plants in general; indeed, to practise the same modes of treatment in a genial soil, situation, and climate, as in an ungenial, would not only prove a loss of labour, but in some cases highly injurious to plants. We must not therefore, contemn the practice of the Egyptian Peasant. Artless as it appears, it is all that is necessary for him to perform, in order to obtain the most abundant crops of grain and pulse that are produced in the world.

From the preceding, it is evident, that in many instances the simple or certain effects of culture do not materially differ from those of a genial soil, situation, and climate; yet that they differ in some respects, and that their difference is greater in some species than in others, is certain; nor is it unreasonable to conclude, that notwithstanding their apparent sameness in some species, it is but in few, if in any, that they are the same in every particular. Different arguments might be adduced in support of this statement, amongst which, that of the majority

of cultivated species experiencing changes that are wholly unknown to plants in their natural or wild state, is certainly not the least cogent.

Dependent Erratic Affections incident to plants in a state of cultivation, or such as culture may or may not produce.

Impletion, prolification, crispation, and *procerity,* are the most prevalent affections that occasionally proceed from culture; yet others occur, as certain *changes in colour* and *floral variegation,* of which it is to be observed, that though less prevalent, they are more decidedly the effects of cultivation, and for that reason more strictly pertain to this subdivision.

Impletion.—This is a luxuriance, that consists, in a fullness of the flowers, arising from the multiplication of certain parts of the *corolla:* or, it is a fulness occasioned by the partial or entire transformation of the *stamens* and other essential parts of fructification into *corolla*—a change by which the plants are rendered either partially or wholly barren. In simple flowers, this fulness in some species proceeds from the multiplication of the *petals,* and in others, from that of the *nectarium;* and in compound or aggregate flowers, it in some species proceeds from the multiplication of the florets of the radius, and in others, it proceeds from the enlargement and transformation of those of the disk. Thus, it proceeds from the *petals,* as in *Anemone* and

Ranunculus; from the *nectarium*, as in *Aquilegia* and *Nigella*; from the radius, as in the *Dahlia* and *Achillea*; and from the disk, as in *Scorzonera* and *Lapsana*. It is to be observed however, that even in the same species, the Impletion does not invariably proceed from the multiplication of the same parts.*

Prolification.—This luxuriance differs from *Impletion* in its being a multiplication of whole flowers and not of their parts: in simple flowers it is from the centre, as in *Rosa* and *Geum*; and in compound or aggregate flowers it takes and place at the side, as in *Bellis, and Scabiosa.*

Crispation:—This when a luxuriant affection, consists in an enlargement of the softer and more pliant parts of the leaves of plants, while their fibrous and more rigid remain unaltered.†

Procerity.—This is a luxuriance incident to certain

* In the flowers of the *Aquilegia*, impletion is observed to take place in three different ways: by the multiplication of the *petals* and exclusion of the *nectaria*: by the multiplication of the *nectaria* and exclusion of the *petals*; and by the multiplication of the *nectaria* while the petals are retained; in which last case, the spaces between each of the five *petals*, are filled up with a triple case of *nectaria*. The like irregularity, is observed to occur, in some species having compound or aggregate flowers; thus, in *Tagetes* and *Matricaria*, the Impletion or filling up of the flower, proceeds in some instances from the disk, and in others from the radius.

† When this enlargement takes place in central parts of the leaves of plants, or in leaves that are bound together by strong ligaments, they in that case, appear as if covered with blisters, and are then termed *bullate*.

plants, by which they attain a size that far surpasses other plants of the same species or variety: as Goliaths and O'Briens are to the generality of the human species, so are vegetable giants to the generality of theirs. In every particular they are the same as other plants of their species, only larger; and it is worthy of remark, that all plants of this description that belong to the same species or variety, attain the same or nearly the same degree of magnitude.

In addition to the preceding luxuriances, there are others that are more circumscribed, which only happen unto some few species, and to them but seldom. Thus, in *Primula*, there are instances of a luxuriance by which the segments of the *calyx* are enlarged and become patent: in *Plantago*, there are instances of the *bractea* being enlarged so as to have the appearance of a rose: in *Dianthus*, there are instances of the *squamæ* of the *calyx* being multiplied so as to form a spike; and in the *Ranunculus, acris*, and *bulbosus*, there are instances of the flowers being produced in a kind of umbel, upon monstrous peduncles, that are without joints or articulations.—In every species luxuriances occur, nor are they confined solely to cultivated plants, but sometimes happen to plants in a state of nature; yet, as thousands of luxuriant plants are produced in a state of cultivation for one that is produced in a state of nature, we are justified in regarding them as the effects of culture, or at least, as such, with few exceptions.*

* Though luxuriances are far more prevalent amongst cultivated plants than amongst the wild or uncultivated, it does not appear that the former experience any luxuriance which the latter do not occasionally experience likewise; hence, no species of luxuriance can be considered as peculiar to cultivated plants, though more strictly pertaining.

Of luxuriances, the most prevalent is that of *Impletion*; yet this species of luxuriance, though the most prevalent of any, is in a great measure confined to plants that have polypetalous flowers, while even amongst them, some experience an impletion so seldom, that we can trace all the double or full flowering plants of the species to an individual. Thus, all plants of the double-flowering peach that are at present in Britian, have been propagated by means of buds and scions, from a plant that was introduced or appeared about the time of Parkinson, who, in his *Paradisus terrestris*, published in 1629, says, "it hath not been knowne, long before the writing hereof."

The *Erica vulgaris* or common heath,* affords a similar instance of the rare occurrence of *impletion* in a monapetalous species, and of its propagation by artificial means; and as another instance of its rare occurrence though not of its propagation by art, that of the *Arenaria verna* may be mentioned, a double-flowering plant of which was found upon Arthurs-Seat, a hill in the neighbourhood of Edinburgh, by a Student of Botany, who, pulling it hastily out of the ground, had the misfortune to injure its roots so very much that it died in consequence, an accident the more to be regreted, from its being the only plant of the species

* The first plant of the *double-flowering heath*, and that from which all the double of the species have been propagated, was, as I am informed, discovered upon Hounslow Heath, a Common about ten miles to the westward of London. When found, it might be looked upon, as the only double-flowering plant of a genus that consists of more species than any in existence, and as the only double of a species that certainly covers a greater portion of the surface of this Island, than any one species indigenous to the climate.

that was ever known to have flowers of that description.

But notwithstanding these, and other instances not less rare, Impletion is without doubt of more frequent occurrence than any other luxuriance, for a proof of which, I would refer the reader to the different species and subspecies of *Rosa*, *Dahlia*, *Dianthus*, *Tagetes*, *Calendula*, and *Mathiola*, of which thousands of double-flowering plants are produced annually from the seeds of the semi-double and single flowering.*

The next most prevalent luxuriance is that of *Procerity*. Indeed, it is not improbable, that every species of vegetable may have its giants; yet upon consulting experience, it will be found, that this luxuriance is more limited than that of *Impletion*; for, with the exception of the cultivated field or garden pea, there is no species wherein giant plants are known to abound; and even in that species, they are in a great measure confined to particular varieties.

It is farther worthy of remark, that species subject to impletion, seldom produce giant-plants, and that, species that produce giant-plants, seldom produce plants with double, multiplicate, or monstrous flowers—a circumstance, from which which we may reasonably infer, that the diversity in luxuriant plants, is more owing to a differ-

* Few species, if any, are more subject to Impletion than those of the *Mathiola*, *annua*, and *incana*, but even in them, our utmost endeavours fail to produce a general Impletion; though by having recourse to pampering methods of treatment, the plants retaining their natural or primitive character, may be reduced to a fourth, or even a less number.

ence in the species affected, than in the causes which affects them.

When luxuriance causes distortion or an unnatural multiplication of parts, which obviously tend to barrenness and the reduction of the species, as in cases of Impletion, we cannot be deceived by it, or led to suppose, that the plants changed, are in consequence, transformed into distinct varieties of their species; but when it causes Procerity, it is possible, that the most attentive observer may be deceived for a time, and led to conclude that the plants changed are no longer the same, but different varieties or subspecies. Their true character however, will be ascertained upon their renewal from seed; for, there is not an instance of plants that are simply giant-plants, continuing to produce others that are gigantic; yet as, *Procerity*, *Prolification*, *Crispation*, and indeed, any casual distinction that is not inimical to health and the perpetuation of the species, may become a specific or lasting distinction by its union with other distinctions, and as one change frequently induces another, it is of importance to examine such plants, and to observe, whether they may not differ otherwise from plants of the species or subspecies whence they have sprung, than in their being tall, curled, &c.

Changes in Colour.—In a state of nature, some species it has been already observed, experience changes in colour from a difference in soil, situation, and climate, while others experience the like changes from adventitious causes; but in a state of cultivation, the same or similar changes not only occur more frequently, but others are produced or occur, that are wholly unknown to plants in their natural

state. Floral variegation, of which we have instances in the rose, aster, pink, carnation, tulip, and other species, is a change of this description; and all changes from a light to a dark colour in the flowers and roots of plants may be regarded as such; for upon enquiry it will be found, that in no concoloured species is there an instance of a plant being produced in a wild state with variegated flowers, nor of a plant belonging to a species with light-coloured flowers or roots, having produced in that state dark-coloured flowers or roots.

Of floral variegation, and of changes from a light to a dark colour, and of all other changes that are attributable to the agency of man, and which are never generated independent of his power, it is to be observed, that a course of treatment must necessarily precede their existence; that is, the plants changed, must be the produce of plants that have experienced a course of treatment before such can possibly happen. Thus, the general productiveness or fertility which culture produces in the majority of species, if not in all, we know to be such as requires the labour and attention of years to produce it, and that if lost, the like labour and attention is required to regain it; yet the same is only the simple effects of culture, and the predisponent cause of all other changes that are peculiar or solely confined to cultivated plants.

In that scale of causations which extends from the marks that characterize individuals of the same species to the marks which characterize distinct species and subspecies, there exists an uninterrupted chain of connection. —Affections that proceed from simple causes, are the

causes of affections more complex; and such as proceed from complex causes, are the causes of others more complex still:—the more simple, the more general they are; and the more complex, the more rare their occurrence; and while some when conjoined acquire stability or permanence from their union, others evidently never can. To this last-mentioned description of causations belong floral variegation and impletion: the former is an unnatural association of colours, and the latter an unnatural multiplication of parts; or, the former is an incongruous union of the distinctions which nature has intended to characterize different species and subspecies, while the latter is a state of being that evidently tends to sterility and the reduction of the species; it is not to be expected therefore, that they can ever become fixed, permanent, or specific distinctions. But of simple or entire changes in colour, and of a multiplication of parts that produces or tends to produce fertility, and of all causal distinctions of a similar character, it is only necessary that the same should be conjoined with others between and which there exists an intimate affinity, in order that they may become specific or lasting; and that this union, is all that is required to constitute a permanence of character, the following will evince:

Thus, in the *Phaseolus multiflorus* or scarlet-runner, we have an instance of a species that consists of five nominal varieties; viz, *the scarlet, the large white, the white Dutch, the Canterbury,* and *the variable*:—All these, with the exception of the first, have white flowers; and all, with the exception of the last, reproduce themselves with the like constancy: the first is the primitive variety or species, the second, third, and fourth, are secondary varieties or species.

that have sprung from the first, while the fifth and last is the same as the first, but differing in colour only. Now, here we not only have an instance of three varieties with white flowers reproducing themselves with the like constancy as their original, the flowers of which are scarlet, but of the original repeatedly producing plants with white flowers, which, when produced, are incapable of transmitting the said distinctions to their posterity—a satisfactory proof that a difference in colour, when supported by other distinctions, becomes a specific or lasting distinction; but when unsupported, that it only exists as a dependent or transient affection. Of magnitude, and indeed of any distinction that is not at variance with the simplicity of nature, or rather that does not exist in opposition to it, similar references can be given. Thus, that variety of the cultivated pea, known by the name of the *Blue Prussian*, grows to the height of four feet, and produces giant plants of six: but the giants of this, like the giants of every other variety or species, are incapable of continuing to produce plants of the like magnitude; yet every gardener well knows, that there exist certain varieties or subspecies of the pea, that grow to the height of eight, and even ten feet, and reproduce themselves with constancy. Hence, a difference in magnitude that is secondary, like a difference in colour that is secondary, is in some instances a dependent or transient affection, and in others a specific distinction.*

* There is probably not to be found, in the varieties of any species, animal or vegetable, a greater difference in magnitude, than in those of the Pea: some even attain a height of ten or twelve feet, while the height of others does not exceed ten or twelve inches.

Thus, in tracing causal affections that depend upon the causes of their origin, we are imperceptibly led from the simple, or consequent and certain, to the erratic or uncertain, and from them to the still more complex and rare; which last are evidently such as no longer depend upon the presence of the external causes that produce them, but exist by virtue of their union, and in consequence thereof constitute a distinct class of affections,—nor a distinct class of affections only, but a distinct class of beings, in the study and knowledge of which the interests and comforts of man are more particularly concerned, than in that of any other branch of Botany.

CAUSAL BOTANY.

PART III.

SUBSPECIES, OR VARIETIES OF THEIR SPECIES.

A SYNOPTICAL VIEW OF SUBSPECIES, EXHIBITING THEIR ORIGIN—THEIR CLAIMS TO SPECIALTY—THE PARTICULARS IN WHICH THEY DIFFER FROM PLANTS, THE DISTINCTIONS OF WHICH DEPEND ON A DIFFERENCE IN EXTERNAL CAUSES—THEIR SIMILARITY TO SPECIES THAT ARE OF PRIMARY ORIGIN—THE CAUSES OF THE INSTABILITY OF THE CHARACTERISTICS OF SOME, AND PERMANENCE OF OTHERS—THEIR DIVISION OR CLASSIFICATION, &c.

Of the Origin of Subspecies.

In the first part of this Volume, it is stated that Subspecies are plants of secondary origin, endued with the like power of transmitting their distinctions to posterity, as

the species whence they sprung; and that their special distinctions, or the marks which characterize them, are the same as the marks which characterize original species; namely, difference in *form, proportion, magnitude, colour, taste, smell, duration, fertility, time of flowering*, &c.—But though this definition or character of Subspecies is strictly applicable, yet, as it differs materially from that which the generality of authors maintain to be the true character of all plants, the distinctions of which are of secondary origin, it follows that the present inquiry leads to an obviating of objections, and to that which some may be disposed to consider and designate a conflict of opinions. On this subject, however, I beg to observe, that though the obviating of objections is a step necessary to the detection of error and the elucidation of truth, yet to meet opinion with opinion is a controversy in which I do not intend to engage. The doctrine now advanced, I shall defend by a reference to simple facts. These, indeed, are the most satisfactory proofs of its validity; nor, in its support, is it necessary to have recourse to any other means or species of defence. Yet in this inquiry, as in all that are of a similar character, it is necessary that we should divest the mind as completely as possible of that prejudice to which human nature is so subject;—that we should mark well that which experience teaches, and diligently seek the truth, which can alone benefit mankind and survive the test of strict investigation.

Of the various subjects relating to Subspecies, or Varieties of their Species, and which the elucidation of their character leads us to investigate, that of the causes of their origin demands particular attention. In order to arrive at

a knowledge of this subject, that is, of the causes to which Subspecies or Varieties of their Species owe their beginning, we must refer to that part of the work wherein Dependent Affections incident to plants are described. There we will find, that so long as plants continue in a state of nature, they either retain their primitive characteristics, or are distinguished by acquired distinctions that depend upon a difference in extraneous causes, or by incongruous and acquired distinctions that are at variance with the simplicity of nature, and which, experience proves to be fleeting and unstable. Now, as it can be proved, that the marks which characterize Subspecies, do not depend upon a difference in extraneous causes, nor exist as incongruous distinctions, it follows, that they do not derive their distinctions, or in other words their being, from the causes by which plants are affected in a state of nature, and as they do not derive their being from the causes by which plants are affected in a state of nature, then must they derive it from the causes by which plants are affected in a state of cultivation: thus, culture is the cause of their origin.*

* Experience sufficiently testifies, that it is in a state of cultivation, when plants have every attention paid to them, and when all the art and skill of the cultivator is exerted to maintain them in a state of health and vigour, that they prove most variable, and are subject to the most remarkable changes. Nor is it difficult to account for this, for in that state, plants are not only liable to changes from difference of soil, situation and climate—from storms, contusions, and the numerous causes which affect them in a state of nature, but to such as proceed from artificial treatment. It it thus, that changes the most complicated happen unto cultivated plants, which though peculiar to them, are not the effects of artificial treatment alone, but the joint effects of innumerable causes.

That culture is the cause whence Subspecies or Varieties of their Species proceed, is manifest from the simple fact of their being confined to cultivated species. Yet, though it may be considered as the cause whence plants of this denomination proceed, it is not to be considered as the sole cause, or as a cause that will invariably produce them; for, although they are peculiar to cultivated plants, experience shows that they are seldom generated even in a state of cultivation. Indeed, so far are Subspecies from being the certain fruits of cultivation, that in *Thymus, Cannabis, Ribes, Helianthus, Crambe, Spinacia, Reseda,* and *Allium,* we find species, which, though long the objects of culture, are nevertheless such as continue to retain their primitive characteristics: a circumstance, from which we are almost led to infer, that their characteristics are even beyond the power of culture to alter.*

Farther, though culture may be considered as the cause of Subspecies in the vegetable kingdom, it is not to supposed, that all plants of that description derive their being direct from culture. On the contrary, by far the greater number of the Varieties or Subspecies now in being, are of the intermediate kind; that is, they are generated by the sexual intercourse of such as are previously produced by cultivation.

* In the cultivated species of *Thymus, Spinacia,* and some other genera, there certainly exists varieties, but of such, it is to be observed, that they differ materially from the varieties we are justified in regarding as secondary species.—They do not, like them, produce intermediates by their intercourse; nor are they produced by culture, but by an accidental disjunction or separation of the sexes.

As the preceding remarks evince the principal cause of Subspecies in vegetables, I shall not detain the reader by attempting a more minute investigation of their origin. Indeed, to particularize the causes which induce certain plants to assume characteristics different to those of the primary species to which they belong, when growing in the same soil, situation, and climate, and when experiencing from the cultivator the same treatment; that is, to point out the causes why some become more early, others more late—some more tall, others more dwarf; and in short, why they assume a multiplicity of distinctions that baffle enumeration—may be considered as an impracticable undertaking: be this as it may, I shall not attempt their elucidation, but shall proceed to lay before the reader proofs from which it will appear, that Varieties of their Species, are Species of secondary origin endowed with the like power of transmitting their distinctions to posterity as the Primary Species whence they sprung.

Of the Marks, Properties, and Peculiarities that distinguish Subspecies, that constitute their character, and evince their being specifically distinct.

Before attempting to prove, that in vegetables specific distinctions are generated by culture or the agency of man, it is necessary that we inform ourselves of the marks or properties that constitute a species and evince a specific difference.

Now, the only sure and unexceptionable mark of a species, consists in its being endowed with the power of transmitting its distinctions to posterity, in obedience to nature; that is, in obedience to general external agency or the laws which pervade creation. It is the possession of this power that constitutes a species; and all distinctions that are transmitted to posterity in this way are to be considered as specific.

Of the marks that distinguish Species, or that indicate the existence of a specific power in plants specifically distinct, the principal are—difference in *form, proportion, magnitude, colour, taste, smell, duration, fertility,* and *time of reproduction.* But as it has been found, that specific differences depend more upon a difference in structure or form, than upon any other perceptible difference, it is agreed therefore that a difference in form is the most eligible and sure mark of a specific difference.

In these conclusions, all who have treated of animal and of vegetable species alike agree, and thus far the popular belief entertained of a specific power and a difference is certainly justified by reason and experience; but as we prosecute our enquiries, we shall find with respect to specific distinctions, that certain opinions have been advanced, and have gained an equal share of popular belief, or at least acquiescence, that are most exceptionable.

Thus, it is asserted and generally believed that species, or plants that possess the power of transmitting their distinctions to their seminal offspring, are solely confined to the different *forms* of vegetables that were produced at

the creation; and that all their causal or secondary distinctions depend upon a difference in extraneous causes.* But this doctrine, though advanced by Botanists of the highest respectability, I must oppose; because, it is not justified by experience, nor by the principles of scientific botany.

So long as we confine our observations to plants in a state of nature, appearances are certainly such as to induce the belief that all that are specifically distinct have existed from the beginning; but when we extend our observations to cultivated plants, and examine them carefully, we will be convinced of the fallacy of that conclusion.

The changes plants experience in a state of nature, as have already been exemplified, are simple, of frequent occurrence, and familiar to every observer; but there is not a season that passes in which culture is not directly, or indirectly, the cause of something new—of a something which the world never saw before, or at least of that of which we possess no previous knowledge. By culture Secondary or Subspecies are produced, which, when produced, generate others by their sexual intercourse, and in some instances plants of this denomination are encreased in this manner, until their numbers baffle enumeration. That some of them differ in *form* from the primary species whence they sprung, others in *magnitude*, and others in

* Species tot sunt, quod diversas formas ab initio produxit infinitum Ens; quæ formæ, secundum generationis inditas leges produxere plures, at sibi semper similes. Ergo Species tot sunt, quot diversæ formæ structuræ hodienum occurrent. Caroli Linnæi, *Philo. Bot.* *p.* 103.

their *time of flowering*, &c. is a fact of which we have ocular proofs;—in short, we have only to examine them, in order to learn, that they differ as original species; and we have only to judge of them by the rules that have been laid down with the intention of distinguishing them from original species, in order to learn that their distinctions are specific; for, so far are those rules from proving, that all the acquired distinctions of plants are dependent or transient, they are the very means by which we ascertain that their acquired or secondary distinctions are sometimes of an opposite character.

Thus, in Botanical Works of the elementary kind, we are informed, that "*magnitude* is no specific difference but a variety, being liable to alteration from soil or climate:"—that "*colour* is found so changeable in the same species, that it must be considered as a variety only:"—that "*time of flowering* is a treacherous mark of a distinct species; and unless supported by other distinctions can only be considered as a variety."* Of *taste, smell, duration, fertility*, &c. similar descriptions are given, so that we are ultimately led to conclude, that a difference in *structure or form*, is the only sure mark of an original species. But a very slight knowledge of the acquired distinctions of plants, or of the changes they experience, shows, that *form* is not immutable,

* See LEE's *Introduction to Botany*, p. 241.

Of the descriptions above quoted, that which relates to a difference in time of flowering is most correct. Indeed, it is applicable to every mark, property, or quality by which plants are distinguished; for no mark, property, or quality, constitutes a specific difference of itself. It is from the harmonious union of distinctions that plants derive their permanence of character; and it is the incongruous union or assoication of their distinctions that is the cause of their instability.

but like *magnitude*, and other distinctions, liable to change; with equal propriety therefore, may it be said of *form* as of other distinctions, that a difference in the same is no sure mark of an original species, because plants are liable to changes in *form* from culture and other causes.—It reads equally well, and is equally true, nor is there a man endowed with the use of his senses, who, upon seeing a cauliflower and an early York cabbage, cannot perceive a difference in their form; or, who could not blind-fold, distinguish a globular from a fusiform radish if put into his hands. That they (the plants just mentioned) differ in *form*, none can deny; and that they, though varieties of their Species, are endowed with the power of transmitting their distinctions to their seminal offspring, is not only confirmed by experience, but deducible from the criterion that indicates a specific difference: namely, a difference in *structure* or *form*.

From these remarks, however, the reader must not conclude that every change in the *form* of plants is specific; nor must he conclude that every difference existing between them in *magnitude, colour, taste, smell, duration, &c.* is transient, or maintained by a difference in extraneous causes. The truth is, a difference in *form* may exist as an original and specific distinction; it may exist as a secondary and specific distinction; or it may exist as a dependent affection.

Thus, the difference that exists in the *form* of the *Bee* and the *Rocket Larkspurs*, is a primary and specific difference; the difference that exists in the *form* of the *English* and the *Scotch Laburnums*, is a secondary and specific

difference; and the difference that exists in the *form* of the *Ranunculus acquatilis* when growing on land, and when growing in water, is only a dependent affection. To contend therefore, that all difference in the *form* of plants is primary and specific, is absurd; and to contend that all secondary difference in their form depends upon a difference in extraneous causes, is contrary to experience, and equally absurd; but to contend that a difference in their *form* as in their other properties or qualities, is a transient distinction, unless when supported by others, is philosophical and just.

A specific difference, or a difference that may be transmitted to posterity by natural generation independent of a difference in extraneous causes, is never embodied in a solitary quality or property, but extends to different qualities or properties. It is not necessarily an original difference, nor is it strictly an immutable difference; for, agreeable to experience, none of the marks, properties, or qualities, by which species are distinguished, are exempt from incidental changes; and whenever they experience a *complete* or a *harmonious* change in the marks which characterize them, then are they endowed with the power of transmitting the same to their progeny. Thus, a specific difference consists in an association of distinctions between which there exists an intimate connexion: this association may be primary, or it may be secondary—it may consist of marks that are conspicuous, or such as are minute; in short, it is the power a plant possesses of transmitting its distinctions to its offspring that constitutes it a species, and it is from the union and association of its characteristics that it derives that power, *et pretera nihil.*

As the specialty or permanence of distinctions depend upon their union or connexion, it is evident, that when a plant experiences a change in any one property or quality that it only experiences a transient change, or such as it cannot transmit to posterity, by natural generation, in the absence of the cause or causes which produced it; because, no mark, property or quality, constitutes a distinct species, or a specific difference of itself. But when a plant is found to differ from the primitive character of the species to which it belongs, or from which it sprung, in two, three, or more properties, then is there good reason to believe that it has experienced a change that constitutes it a secondary species; and when we can trace certain of its acquired distinctions to a difference in *structure* or *form*, then are we certain of its being such. For although a difference in *structure* sometimes exists independent of a specific difference, as is frequently the case with a difference in *magnitude* and other distinctions; yet, it is not to be supposed, that a specific difference exists, and is manifest in the exterior appearance or preceptible properties of plants, independent of a difference in their *structure*.

Of all other distinctions, a difference in *structure* or *form* is the most certain mark of a specific difference; then follows, difference in *duration*, in *time of flowering*, and in *fertility*; and then, difference in *taste*, in *scent*, in *magnitude*, and in *colour*. Hence, by attending to the claims the said properties or qualities possess to that of a specific difference, and by observing the relation in which they exist, we are enabled to ascertain the character of the plants which they distinguish. When specific, it is by reason of their intimate connexion or the harmonious relation in

which they exist; and when transient or unstable, it is by reason of their incongruity.

Experience and philosophy alike evince the truth of this conclusion, and the principles of scientific Botany are evidentally founded thereon:—a fact, which a reference to any system or method of distinction and arrangement that ever has existed, or that now exists, will at once testify. The means therefore, by which we ascertain the being or existence of Subspecies in the vegetable kingdom, is not hypothetical, but that by which the different species of animals and vegetables ever has been and ever will continue to to be distinguished; in short, it is a rule of distinction and arrangement which nature recommends, and which the experience of ages justifies.

In order to illustrate this method or rule of distinction more fully, and to show that it applies alike to distinctions that are secondary and primary, I might proceed to particularize the *forms* that indicate the existence of certain properties in species that are primary, and then, by a reference to secondary species, show, that the same, or a similar difference in their *form*, indicates the same or a similar difference in their properties. Thus, I might prove that a difference in *time of flowering* that depends on a difference in *time of sowing*, or on a difference in *soil*, *situation*, and *climate*, is not specific; but that a difference in *time of flowering* that depends upon a difference in *structure*, is specific; and that the *forms* which indicate the existence of that difference in Subspecies that have sprung from the same Species, are exactly the same as the *forms* which indicate the existence of the same or a similar difference in Species

of the same Genus. But it is unnecessary to have recourse to this species of proof in order to justify the doctrine now advanced, as proofs the most exceptionable, may be obtained from a comparative and less minute view.

A View of Primary and Subspecies, from which it is inferred that the Distinctions of the latter are Specific.

Upon comparing Subspecies with Species of primary origin, we find that they are distinguished by marks that are the same, and that there is no peculiar mark or badge by which they can be known as such.

The works of different Botanists sufficiently evince the truth of this statement.

Thus, in some botanical works we find the *Medicago, orbicularis, tornata, turbinata, arabica, muricata, intertexta, scutellata, maculata, rigidula,* and *laciniata,* described as varieties of the *M. polymorpha,* while in others, they are described as original species. Some Botanists are of opinion that the *Triticum, æstivum, turgidum, hybernum,* and *polonicum,* are original species, yet there are others whose opinions are not less worthy of credit, that believe

them to be varieties of the same species.* But the fact is, neither they who assert that they are primary, nor they who assert they are secondary, are able to prove their assertions. That the plants in question are distinct, is certain; and that they are specifically distinct, is evident from the power they possess of transmitting their distinctions to posterity; but whether they are originally distinct, or casually distinct, is that which we are unable to ascertain; nor is it of any service to know whether they were produced a hundred or a hundred thousand years ago; yet, it may be of service to know, that they are endued with the power of transmitting their distinctions to posterity, and that all their Subspecies or Varieties that may hereafter exist, will be found to possess the same power.

Should any man contend that *mazagan, nonpareil,* and *longpod-beans,* like *summer, winter,* and *polish wheat,* were originally distinct, no one could, from marks or properties observable in them, prove that they were otherwise.—They reproduce themselves with constancy, and if permanence of character is to be admitted as a proof of one plant being original, it must of another; but permanence is no proof of

* In *Primula, Amygdalus, Fraxinus, Ulmus, Ononis, Thymus, Circæa, Salix, Pyrola, Agrostis,* and other genera, species of doubtful origin occur, which by some are described as original species, and by others as varieties.

When species of this description are found in a state of nature, the probability is, that they are either primary or hybridous; but when found amongst cultivated plants, their origin is more doubtful as in that case they may be primary, secondary, or hybridous.

the existence of an original distinction, though it certainly is, of the existence of a specific power.

If permanence of character (agreeably to the general received opinion,) was the distinguishing characteristic of Primary Species, and if the distinctions of Subspecies were maintained by a difference in extraneous causes, or by the presence of the causes that produced them, then would there exist a rule by which we could distinguish the primary from the secondary.—The stability of the former, and the instability of the latter, would afford the most satisfactory proofs of their origin; but of their origin we have no such proofs; and hence the inability of Botanists to ascertain the same.

But notwithstanding our inability of distinguishing Primary Species as primary, and Subspecies as species of secondary origin, we find, that the latter (when known) are described in all works on Botany and Gardening, as plants naturally unstable, and prone to change. We are told that the Subspecies or Varieties produced by culture, are only prevented from resuming the primitive characteristics of the species whence they sprung, by their continuing to be the objects of culture. But this is no other than a groundless assumption; indeed, of secondary or casual distinctions, that depend upon the presence of the causes that produce them, none are transmitted from generation to generation unless of general occurrence; that is, unless they are common to all plants of the same species, when in the same soil, situation, and climate, and when experiencing the same treatment. The consequent

or certain effects produced in plants by culture, depend upon culture, and only cease to exist when their culture is neglected.* But with respect to the erratic or uncertain effects of culture, the case is otherwise; for although they may be frequently or repeatedly produced by it, yet it is incapable of enabling the plants to transmit them by seed to posterity.† Now, as culture is incapable of maintaining distinctions, which it is known repeatedly to produce, who can for a moment suppose it to maintain distinctions, which in some species it does not produce once in a century, or even in a thousand years; and which, to the best of our knowledge, it never produces twice? Certainly, no man upon reflection, can believe that such is the case; yet it is a well known fact, that the numerous Varieties or Subspecies of *peas, beans, kidney-beans, wheat, oats,* and *barley,* reproduce themselves with constancy; that is, with the like constancy that species which have existed, *ab initio,* are found to do when subject to culture; it must be, therefore, that they differ specifically.

The rare occurrence of Varieties or Subspecies is a satisfactory proof of the rare association of the causes that produce them, while their difference in every specific property or quality can leave no doubt on the mind as to their being generated by causes the most opposite. To believe that such as are *tall, dwarf, sweet, sour, branching, capitate,* and otherwise distinguished, are all maintained by the presence of the causes that produced them, when experiencing

* See Dependent Consequent Affections produced by culture.

† See Dependent Erratic Affections produced by culture.

the same treatment, in the same soil, situation, and climate, is really absurd. It cannot be, that they who profess to believe that such is the case, in the least reflect on the rare association of causes from which Subspecies derive their being.

The probability is, that the association of causes that gave birth to any of the Subspecies now in being, never existed but once, and may never exist again. Their reproduction otherwise than by natural generation, is a thing unknown; at least it is an occurrence of which neither history nor our experience informs us. Thus, though thousands of giant-plants of the *charlton, crown,* and other Subspecies of the cultivated pea, are produced annually from the seeds of plants that are not gigantic, never but once was the *charlton-pea,* or the *crown-pea,* produced by plants that were not *crown* or *charlton;* yet those two varieties of the pea have existed for centuries, and may until the end of time. General experience testifies, that they maintain their distinctions in different soils, situations, and climates; and the experience of every cultivator informs him that they, like the Subspecies or Varieties of *wheat, oats,* and *barley,* maintain them when experiencing from him the same treatment—an incontestible proof that their distinctions are specific. So long, however, as they continue to be the objects of culture, so long will they be subject to the changes incident to cultivated plants; yet their producing of giant-plants, and of different Varieties or Subspecies from time to time, is no proof of their being naturally unstable, or more prone to change, than Species that have existed from the beginning. Had not the *original pea* been subject

to the like changes, *charlton* and *crown-peas* never would have existed.

From these remarks, it is sufficiently obvious, that Subspecies differ as Original Species differ, and that they are endued with the like power of transmitting their distinctions to posterity. It is to be observed, however, that though they are endued with the power of transmitting their distinctions to posterity, it is only such as have sprung from certain Primary Species that continue to retain that power. Thus, the Subspecies or Varieties of the *Avena sativa*, the *Pisum sativum*, and the *Vicia Faba*, reproduce themselves with constancy, while those of the *Vitis vinifera*, the *Pyrus Malus*, and the *Prunus Cerasus*, are most variable. But this difference does not proceed from an inherent proclivity in the Subspecies of the latter to change, nor is it the immediate effects of culture, but of their sexual intercourse.

On the Instability of certain Subspecies, and Permanence of others.

As the instability so prevelent amongst certain Subspecies and unknown amongst others, is a subject equally interesting and curious, and as its illustration throws much light upon the economy of vegetable life, it may be well, therefore, to enquire into it with all that care and attention which it seems to mirit.

It has been already stated, and I presume satisfactorily proved, that the permanence of the distinctions that constitute a Species depends upon their intimate relation and connexion; that there is no mark or distinction that constitutes a species or a specific difference of itself; that so long as Primary Species exist in a state of nature, they continue to be specifically the same, though liable to numerous changes; and, that it is not until they have been the objects of culture, that their acquired distinctions are ever knewn to exist as specific distinctions.

Now, as culture is known as a cause of specific changes in plants the distinctions of which are primary, we are justified in concluding, that it will produce the like changes in plants, the distinction of which are secondary, and that it may be multiplying distinctions prove an occasional cause of instability in Species that are of secondary origin; yet that wonderful diversity we behold in the Subspecies of certain Primary Species is not thus to be explained. The chief cause of their instability is their sexual intercourse, as the following will evince:—

Upon examination, we find the individuals that belong to certain Primary Species formed for distant sexual intercourse; others for an intercourse less distant; and others we find, that are debarred all sexual communication. Now, experience shows, that the Subspecies or Varieties that belong to such as are most exposed to an intercourse, are the most variable; that they of such as are less exposed are

less variable; and that they of such as are debarred all sexual communication, in general retain their respective distinctions and reproduce themselves with constancy. It is obvious, therefore, that the principal cause of their instability is their sexual intercourse.

That the principal cause of instability amongst Subspecies is their sexual intercourse, is not only proved by experience, but deducible from their constitution; for as their specialty or permanence depends upon the intimate union of the distinctions of which they are severally composed, whatever tends to reduce that association or union of distinctions, must have a tendency to render them unstable. Now, nothing can more effectually disunite and reduce their distinctions than their sexual intercourse one with another; for when an intercourse takes place between two, the properties or qualities of which do not harmonize, a third is produced, possessed of certain incongruous properties or qualities which it is unable to transmit to its offspring. Thus, though the sexual intercourse of Subspecies has the effect of increasing their numbers, yet by effecting a reduction of the properties or qualities of which they are severally composed, it produces incongruity, and proves the principal cause of their instability.

But the instability arising from sexual intercourse is not confined to the Secondary or Subspecies of Vegetables but extends to the Primary likewise; and this, as the reader will readily perceive, is another proof that Primary and Secondary Species are similarly constituted; for were they differently constituted, the same causes would not produce

in them the same effects. Yet in them the effects of a promiscuous intercourse is the same, with this difference that the hybridous offspring of Primary Species are in general barren, while the hybridous offspring of Subspecies that have sprung from the same Species, are never otherwise than fertile.* But though the hybridous offspring of Primary Species are in general barren, yet in some instances they are fertile; and when fertile and exposed to an intercourse, the like instability of character prevails amongst them as amongst the hybridous offspring of certain Subspecies.

Thus, the nearly allied species of *Saxifraga*, *Pelargonium*, and some others, when exposed to an intercourse, are not less variable than the Subspecies or Varieties of the *Brassica oleracea* when so exposed. Of upwards of 100 species of *Pelargonium* that were introduced into Britain prior to the year 1800, few retain their primitive characteristics.—He, who twenty years ago could readily distinguish every species of *Pelargonium* then in this island, at present, can scarcely recognise one which he then knew. Indeed, the majority of plants belonging to this genus, no

* It is rare that the hybridous offspring of Primary Species produce perfect flowers: if the male organs are perfect, the female are generally imperfect; and if the female organs are perfect, the male are imperfect. When the former are imperfect, the plants are barren in consequence; but when perfect, seed may be obtained from them by impregnating their flowers with the *pollen* of their parent species. By this means we may obtain hybrids with perfect fructification that will produce seed of themselves; yet experience shews that the plants so obtained, are seldom stable, or capable of transmitting their peculiar marks or properties to their progeny; that is, they seldom produce plants that are the same as themselves.

longer exist as distinct species, but as the joint produce of numerous and distinct species, which sexual intercourse have deprived of their singleness of nature and the power of transmitting their once specific distinctions to their offspring.

But though certain Primary Species are rendered unstable by their sexual intercourse, it is not the case with them in general. Upwards of fifty thousand, exclusive of cryptogamous species, are known to exist; and of these, by far the greater number are such as maintain their respective distinctions by reason of their natural disparity preventing their intercourse, while others maintain them by reason of the peculiar structure of their flowers, and others by a difference in their time of flowering. Of Primary Species, therefore, it is only a portion of those between which there exists an intimate affinity, that are in danger of being deprived of their respective distinctions by their sexual intercourse; yet, though only a portion, they are sufficiently numerous to shew, that by their intercourse, the like instability is produced amongst them as amongst species of secondary origin.

That instability is far more prevalent amongst Subspecies than amongst species of primary origin, is a well known fact; but, if the latter are permitted to grow in proximity to the former that have sprung from them, they will prove equally unstable. Hence it is obvious, that Primary Species only maintain their permanence of character when debarred an intercourse with such as are nearly allied to them in nature. Indeed, were it not that amongst the different species of vegetables, some are prevented from

producing intermediates by reason of their natural disparity, others by the structure of their flowers, others by a difference in their time of flowering, and others by their having different *habitats* assigned them, all that are now in being would intermix and cease to exist. Their intercourse, in producing a division of their properties or qualities, would produce incongruity, and deprive them of the power of transmitting their respective distinctions to their offspring; and as all kinds of fruit, grain, and pulse, would cease to reproduce themselves—as plants the most poisonous would intermix with such as are fit for food, all animals that directly or indirectly depend upon them for support, would be deprived of that support, and would die in consequence. But the wisdom and power of the DEITY is not more apparent in the creation of animals, than in amply providing for their support, by limiting the fertile intercourse of vegetables in the manner above specified. Had that intercourse been more extended, the result would have been most disastrous; and had it been more circumscribed, the world would not have possessed many useful and ornamental plants which it now possesses. Upon the whole, though the sexual intercourse of certain nearly allied Species and Subspecies of Vegetables reduces their distinctions, deprives them of their singleness of nature, and renders them unstable, it is an occurrence that can seldom happen independent of the intervention of human power. Indeed, instances of specific instability are only known amongst cultivated plants; and though more prevalent amongst Subspecies, there are many that retain the power of transmitting their respective distinctions to posterity: but this power, as has been already observed, they only retain by reason of their

being debarred all sexual communication with such as are nearly allied to them in nature.

From these remarks, however, it is not to be inferred that the sexual intercourse of plants nearly allied in nature is a cause of instability as often as it takes place; nor are we to conclude, that instability may not be produced otherwise than by the commerce of the sexes. The truth is, any cause or association of causes, from which specific changes proceed, may either produce stability or instability, because it may either produce a congruous or an incongruous association of the properties or qualities by which plants are distinguished. We know that certain intermediates reproduce themselves with constancy; and it is probable, that by culture the like instability is produced as by the commerce of the sexes; yet it is rare that the intermediate or joint offspring of nearly allied Species or Subspecies reproduce themselves with constancy, and it is still more rare that instability is produced otherwise than by their intercourse.—In short, we have only to trace the effects of sexual intercourse amongst Species and Subspecies, in order to be convinced of its being the principal cause of their instability, nor of their instability alone, but of various phenomena which is not to be accounted for in any other way.

Those who attempt to account for the instability so prevalent amongst Subspecies, by telling us, that in all Varieties there exists a tendency to resume the primitive characteristics of the species whence they have sprung, forget that certain of the Varieties or Subspecies of *peas*,

beans, kidney-beans, &c. in a state of cultivation, have been known to reproduce themselves with constancy for centuries; while the Primary Species of *Pelargonium, Saxifraga,* and some others, when in that state, have been deprived of the power of transmitting their distinctions to posterity;—they allege no cause why the five seeds that are contained in a *Golden-pippin Apple* yield five distinct varieties, nor why we may cultivate the *mazagan-bean* all the days of our life, without being able to detect a variety that it has produced. Those, however, who attentively inquire into the causes of the changes plants experience, will not long remain ignorant of the real cause why certain Varieties or Subspecies reproduce themselves with constancy, while certain Primary Species are incapable. The stability observable in the latter, and in certain of the former, they will discover to be inherent; and the instability so prevalent amongst the former, and which extends to certain of the latter, they will discover to be the effects of their sexual intercourse; while the existence of a tendency in Subspecies to resume the primitive characteristics of their species, they will discover to be imaginary, and that it is as reasonable to suppose, that there exists a disposition or tendency in inert matter to change its position, as to suppose the existence of that tendency in them: for it is equally a law of nature, that plants specifically distinct, shall reproduce themselves, as it is that inert matter shall continue in its present state or remain where placed.

That instances of relapsation may occur amongst Subspecies that are exposed to an intercourse with their congeners, and more particularly to an intercourse with those

from which they have sprung, need not surprise us. We know for a certainty, that three *removals* completely reduces the distinctions of the varieties of the human species; and that, by crossing and recrossing, the different breeds of cattle and other animals may be bred up or down from one Sub-species to another, until no trace remains of their ever having been of a mixed breed. I am not aware that similar experiments have ever been made upon plants, but I have no doubt that, if made, the result would be similar. It is even probable that plants, which by their sexual intercourse have lost the power of transmitting to their offspring the marks which characterize them, might by their sexual intercourse regain that permanence of character of which their intercourse was the means of depriving them. But we must not presume on the truth of this, until experience has furnished the proof; nor must we be guided in our decisions, respecting the effects of sexual intercourse in vegetables, by consulting that analogy which exists between them and animals: for plants and animals, though analogous, differ widely in many respects; and though the end or use of the sexes is the same in both, yet by the intercourse of the sexes very different effects are produced in vegetables to those produced in animals.

In general, the different species of animals consist of individuals that are male, and of individuals that are female; but by far the greater number of vegetable species consist of individuals that are hermaphrodite, that is, of plants in which the sexes are united. But this is not the only particular in which animals and vegetables differ. A vegetable is an aggregate being likewise: it consists of parts which upon separation, become distinct individuals, each male and

female of its species. Nor does the peculiarities of this wonderful being, this compound of sexes and parts, always terminate here: by its intercourse with its congeners it acquires other distinctions which it continues to retain in conjunction with its own; and this is the principal cause why the appearance of plants, that are exposed to an intercourse with others nearly allied in nature, so frequently belie their real state or condition. For although a plant acquires the distinctions of others when impregnated by them, yet it is rare that its exterior appearance, its fruit, or its seeds, are sensibly affected thereby; in general, the effects of its impregnation by a different species or variety, remain hid until revealed by the hybridous plants unto which it has given birth.*

That a plant should differ in appearance from its offspring, when they are not solely its own, but its joint produce with different Species or Subspecies, is that which we expect; but that its impregnation by them should not only cause it to produce intermediates at the time, but for ever after, may appear incredible to some; yet strict observation will not fail to testify that such is the case. In this place, however, I shall not detain the reader by referring to particular proofs of plants participating in the properties or qualities of those by which they have been impregnated. I have only to observe, that instances of the same are confined to those of perennial duration; that it is the cause why all attempts to renew certain perennial Sub-

* This singular and interesting subject, will receive farther explanation, in treating of Varieties of the third class, and in treating of the monade existence of acquired properties in plants.

species from seed, have failed; and that, in treating of such as are exposed to an intercourse with their congeners, this interesting subject will be fully explained.

On the Methodical Arrangement or Classification of Subspecies.

The experience of every cultivator must inform him that amongst plants considered as Subspecies or Varieties of their Species, some reproduce themselves from seed with constancy; others require to be kept apart in order to retain them in a state capable of reproducing themselves; and others baffle all attempts to effect their seminal renewal. Thus, the different varieties of the *Pisum sativum*, or cultivated pea, reproduce themselves with constancy; the different varieties of the *Cucumis Melo*, or melon, require to be kept at a distance one from another, for when in proximity they mix and lose their respective distinctions; while the different varieties of the *Pyrus Malus*, or apple, have hitherto resisted every attempt to obtain them a second time from seed. Now, those that reproduce themselves with constancy, consist principally of such as have secluded fructification and are debarred all sexual intercourse: those that require to be kept apart in order that they may reproduce themselves, have exposed fructification, and consist of annuals and biennials; and those that have resisted all attempts to renew them from seed, have

exposed fructification, and consist of perennials which by their sexual intercourse have been deprived of the power of transmitting their respective distinctions to posterity.

This view of the state in which we find Subspecies or Varieties of their Species, agrees with the Specification at the conclusion of the First Part of the Work: it shows that they belong to three classes, which may be distinguished as follows:—

I. A class consisting of plants that are distinguished by secluded fructification; by being debarred all sexual communication one with another; and by continuing to transmit to posterity the marks which characterize the Varieties or Subspecies to which they belong.

II. A class consisting of plants that are distinguished by exposed fructification; by only flowering once during their existence; and, when of distinct Varieties, by mixing or producing intermediates, if not prevented by distance, by natural disparity, or by a difference in their time of flowering.

III. A class consisting of plants that are distinguished by exposed fructification; by flowering for a greater or less number of years in succession; and, when of distinct Varieties, by mixing, if their intercourse is not prevented by distance, by natural disparity, or by a difference in their time of flowering.

Agreeable to this arrangement, if a Subspecies or Variety of its Species belongs to the first class, we are

justified in regarding it as endued with the power of perpetuating and multiplying itself by seeds; if it belongs to the second, we may presume that it is endued with the like power, unless found in proximity to its kindred Varieties; and if it belongs to the third, the probability is, that it does not possess that power, even though it may not be found in the vicinity of its congeners; for by far the greater number of the Varieties that belong to the third class are not Subspecies, or distinct Varieties of their Species, but their hybridous or mixed offspring, which, though capable of producing seed, are nevertheless incapable of transmitting their respective distinctions to posterity.*

Respecting the merits of this mode of arrangement, it is unnecessary in this place to enquire more particularly. Its utility is sufficiently obvious, while its accuracy as a rule

* As Varieties that belong to the third class are readily propagated by extension, and as it frequently happens that those which have sprung from the same species are allowed to grow in proximity for ages, without an attempt being made to renew them from seed, we need not be surprised at their inability of transmitting their respective distinctions to their seminal offspring; or in other words, we need not be surprised at their being in a more mixed state than the Varieties which the cultivator is under the necessity of renewing every year, or every second year from seed, and which, when nearly allied in nature, his experience has taught him the propriety of keeping apart when in flower;—indeed, were they as stable by nature as the primary species whence they sprung, it would be unreasonable to expect them to maintain a permanence of character under their present circumstances. It is probable, however, that few of them are naturally stable from seed, and though their appearance may seem to justify our distinguishing them as Varieties of their Species, yet the majority are only Varieties of the intermediate kind, and not such as are naturally endued with the power of transmitting their respective distinctions to posterity.

of distinction, will appear in treating of Varieties under the classes now specified. Yet, there is one circumstance respecting this arrangement, which it may be well to notice before we proceed to treat of Varieties under their respective classes. It is as follows:—

Varieties that have secluded fructification, it will be observed, are comprised under one class; while those that have exposed fructification are divided into two classes. Now, though it would be difficult to prove that the division of the former, as of the latter, into two classes, was requisite in order to explain appearances, yet there is much that tends to strengthen that conclusion, if not to place the propriety of that division beyond a matter of doubt. The preceding enquiries sufficiently evince, that the intercourse of plants is not the only cause of the specific changes they experience, nor is it to be supposed that it is the only cause of their instability. We know that culture is a cause of specific changes; and that it may prove a cause of instability in Species and Subspecies that are of perennial duration, is a most reasonable induction: yet, as the certainty of its having produced instability, independent of the commerce of the sexes, may be questioned, the division of Varieties with secluded fructification into two classes, may be deferred, until farther discoveries have proved it to be expedient. In the mean time, no material error can arise from including all that have secluded fructification under the same class as Varieties that are endued with the power of transmitting their respective distinctions to posterity; for upon enquiry, it will be found that such is the character of all that are of that description—those of the *Ficus Carica*, or cultivated fig, alone excepted.

To avoid mistakes, therefore, all that is necessary, is to remember, that the Varieties of the fig are the only inconstant or unstable Varieties which have secluded fructification; and that, when it is asserted that all Varieties having secluded fructification reproduce themselves with constancy, it is to be understood, that those of the fig exist as exceptions.

SUBSPECIES.

CLASS I.

SUBSPECIES OR VARIETIES WITH SECLUDED FRUCTIFICATION.

THE fructification of plants consists of seven parts, namely, *calyx*, *corolla*, *stamina*, *pistillum*, *pericarpium*, *semina*, and *receptacle*.

As these are so very well known, and as they have been so often described, I shall not detain the reader by detailing their several uses in the vegetable economy. I have only to observe, that the *stamens* are the male, and the *pistils* or *styles* the female organs of generation; and that though some species are *dicœcious*, or have their male organs on one plant, and their female on another, yet by far the greater number are *hermaphrodite*, and have them upon the same plant.

That the greater number of vegetable species should be *hermaphrodite*, is only that which we are reasonably led to expect. For as nature has denied them the power of locomotion, it is evident that the existence of the male and of the female organs, on distinct plants, would frequently prevent the intercourse of the sexes, and thereby endanger

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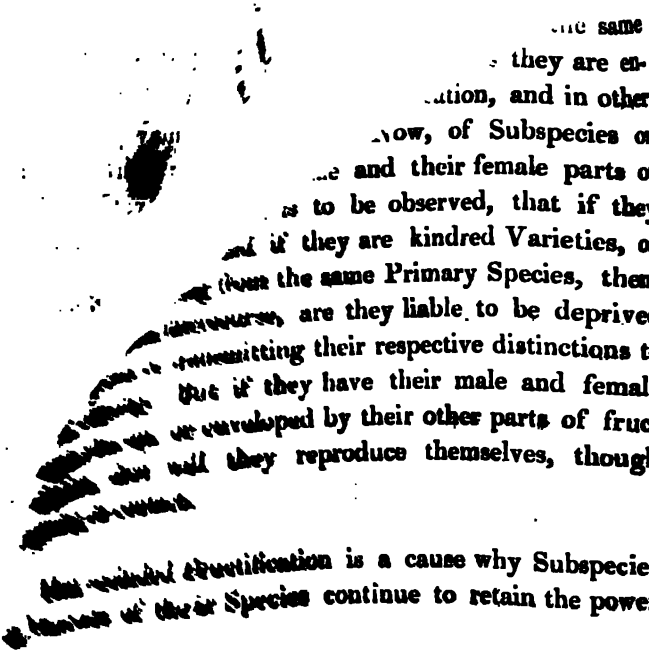

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the existence of the species. Indeed, it is even demonstrable, that if the individuals that belong to the different species of vegetables now in being, were distinct male and female, some thousands of species would cease to exist. But agreeable to that wisdom manifest in the works of creation, we find few species that are strictly *diœcious;* while those that are, have their fructification formed for distant sexual intercourse.

In *diœcious* plants, it is evident that exposed fructification is indispensable to the commerce of the sexes and the perpetuation of the species. But in *hermaphrodite* plants, unless in those that are *androgynous*, this is not the case, because in them the male and female organs have their habitation in the same flower. As the male and the female organs of hermaphrodite plants are situated in the same flower, we therefore find that in some species they are enveloped by the other parts of fructification, and in other species we find them exposed. Now, of Subspecies or Varieties, that have their male and their female parts of fructification exposed, it is to be observed, that if they grow in proximity, and if they are kindred Varieties, or such as have sprung from the same Primary Species, then, by their sexual intercourse, are they liable to be deprived of the power of transmitting their respective distinctions to their offspring. But if they have their male and female organs shut up, or enveloped by their other parts of fructification, then will they reproduce themselves, though growing in contact.

That secluded fructification is a cause why Subspecies or Varieties of their Species continue to retain the power

of transmitting their respective distinctions to posterity, is confirmed by a reference to the Varieties at present in cultivation. Enquire of the farmer what his expectations are, when he commits to the soil the different varieties of the *Avena sativa*, or cultivated oat, and he will inform you that he confidently expects every variety of that species will reproduce itself: nor can he entertain a contrary belief, if he consults his own experience. With respect to the quantity and quality of his crops of oats, he may have been frequently disappointed; and it is not improbable, that in order to remedy the deterioration occasioned by soil or situation, he may have been frequently compelled to procure his seed corn from a distant part of the country: but he was never once deceived or disappointed by a variety of that species having failed in reproducing itself. Upon the whole, it is very evident that the subspecies of the *Avena sativa* are naturally endued with the power of transmitting their respective distinctions to posterity; but as this power is not sufficient to account for their stability when growing in proximity, how comes it that they severally maintain their distinctions when in that state? The answer is—they are debarred all sexual intercourse, owing to the peculiar formation of their flowers.

Thus, in examining a floret of any variety of the *Avena sativa*, we find the rudiments of the seed and the organs of generation inclosed in a receptacle formed by its flat and concave valves. In this receptacle, it is to be observed that the fecundation of the *styles* takes place; and that, though the anthers are sometimes ejected, yet their ejectment never happens until their presence within the valves is no longer necessary. Now, as the fecundation of the

styles takes place prior to the ejectment of the *anthers*, and as the latter, if ejected, are not ejected till they have lost their fertilizing power, it is obvious that under such circumstances they cannot communicate with other varieties. Indeed, did the *anthers* even retain their fertilizing power after their ejectment, they would retain it in vain; for as the *styles* of other florets are shut up in their respective valves, their fecundation can only be effected by the *anthers* of the florets wherein they are inclosed.

As the fructification of the cultivated species and subspecies of wheat and barley, is similar to that of the subspecies of the oat, and as they are known to reproduce themselves with the like constancy, the above remarks respecting the intercourse of the sexes, may be considered as alike applicable. In one particular, however, they differ materially. In the varieties of the *oat*, the *anthers* are seldom ejected, but remain within the valves, and there decay. In the varieties of the barley, they are more frequently ejected, although there are instances of their remaining within the valves; and I have even known the fecundation of the *styles* to take place, in barley, prior to the spike having quitted its sheath: but this never occurs unless in very dry seasons, or when the plants have received some external injury. In the varieties of the wheat, the *anthers* are invariably ejected, but in no instance prior to their having performed that office for which nature has intended them.

Of other Varieties or Subspecies that have secluded fructification, and that reproduce themselves with constancy, the next most important are those of leguminous species. The stability of the different varieties of peas, beans, and

kidney-beans, is well known to the cultivator. He finds no difficulty in saving the seeds of these, as they maintain their respective distinctions when growing in contact. Experience has taught him that it is not necessary he should remove a particular variety of pea or bean to a distance from its congeners, in order to prevent its producing intermediate or hybridous varieties; and he has only to examine the formation of their flowers, to see why that precaution is unnecessary.

In all leguminous Species and Subspecies, he will find the organs of generation situated so as to prevent a promiscuous communication between plants that are contiguous; and though in some the seclusion may not be such as to render their intercourse impossible when in contact, yet in others it is strictly such.

If, for instance, we examine the flowers of any Species or Subspecies that belongs to the genus *Vicia*, we will find the *anthers* emptied, and the whole of their contents deposited upon the *stigma*, some few days prior to the erection and expansion of the *vexillum*, or that period when the flower is said to be full-blown. In them, therefore, it is evident that fecundation takes place at a much earlier period than the generality of observers are apt to suppose, and long before the flowers are visited by bees and other insects for the sake of their nectareous juices. It may be farther remarked, that in *Vicia*, after the flowers are fully expanded, the male and female organs remain inclosed in the *carina*, and there decay. In some leguminous species, however, as in those of *Ulex*, *Genista*, *Cercis*, &c. they frequently burst from the *carina* shortly after the erection of the *vexillum*;

yet the probability is, that they are never exposed until after fecundation.

Those who are desirous of further information respecting the existence of plants with secluded fructification, and of seclusion being the cause why Varieties of the same species maintain their respective distinctions when growing in proximity, will do well to have recourse to personal observation. In certain Subspecies or Varieties, as in those of the pea, they will find that the seclusion, though calculated to maintain permanence amongst those that grow in proximity, is not such as to render it impossible for them to mix when growing in contact; and in others, as in those of the kidney-bean, they will find that the seclusion is such as must prevent the intercourse of the sexes, even in plants that are growing in contact. If they prosecute their inquiries, they will also find Species and Subspecies, which, to the eye of superficial observers, may appear to have exposed fructification, but which in reality have secluded fructification, and may be grown in proximity without mixing.* Nor is this all: in Species of the same genus they will find some with secluded, and others with exposed fructification,—of which there are instances in *Hordeum*, *Triticum*, *Avena*, &c.

* In the classes *Triandria*, *Pentandria*, *Didynamia*, *Diadelphia*, and *Sengenesia*, there are many instances of species and their varieties, which, though they appear to have exposed fructification, are nevertheless to be considered as having secluded fructification. To explain this, it is only necessary to state that the commerce of the sexes, in all such species and their varieties, takes place prior to the male and female organs being exposed.

As the principal object of this inquiry is to exhibit the character of Subspecies, it is not necessary to particularize every plant of that description, in order to arrive at a just decision. The preceding remarks respecting such as have sprung from leguminous species, and from certain graniferous species, may be considered as applicable to all that have secluded fructification: and as the subspecies of leguminous species, and of all others with secluded fructification, reproduce themselves with constancy, we are justified in asserting that all that have exposed fructification would reproduce themselves with the like constancy, if nature had protected them in the like manner.

Upon the whole, a more satisfactory proof is not to be found of the permanency of the distinctions of Subspecies or Varieties of their Species, than that which is afforded by those with secluded fructification. When the seclusion is such as precludes the possibility of their mixing, then, whether annuals, biennials, or perennials, they reproduce themselves with constancy. Early oats and late oats do not reproduce themselves with greater constancy than English and Scotch laburnums: they are alike permanent; and so far is culture from being the cause that enables them to transmit their respective distinctions to their offspring, it is the only cause that can produce in them a specific change. He who by digging, or any other operation, lays claim to the merit of maintaining Varieties, with secluded fructification, in a state capable of transmitting their distinctions to posterity, arrogates to himself the merit of performing that which must take place independent of his interposition;—he lays claim to that which any old woman, though unskilled in the occult sciences, is quite as capable

of performing as himself. He may, in support of his pretensions, refer to the writings of every author on plants, since the days of Theophrastus to the present;—he may contend that the opinion he holds is that which has been entertained by the learned in all ages, and that its truth is therefore unquestionable. But have not similar arguments been urged in support of every erroneous opinion that ever yet commanded general credence, and have we not many proofs of learned men being the dupes of vulgar errors? Did not the learned world at one time believe that it was necessary the Asphodel should be planted in quantities near burying-places, in order to supply the manes of the departed with food; and that if a proper supply was not kept up, hungry ghosts would devour one another? Did they not believe in the dolorous squeaking of the roots of the *Atropa Mandragora*, or mandrake; and did they not believe in the Barnacle-tree, that annually produced crops of geese,—in the Baranetz lamb, that was only permitted to graze to the extent of its umbilical chord,—in plants that were affirmed to stay the tides, to dry up rivers, and to raise the dead;—and, in short, in a thousand delusions which experience, that faithful guide to truth, has proved to be absurd?

Some may imagine that the prodigies of which we read in the works of ancient authors, are such as could not in any age obtain belief, and that they were never believed by men of learning. But the very writings of men of genius and learning show that they were believed. We have an instance of Lord Monboddo writing to Linnæus, on the subject of a race of men with tails, that were reported to inhabit southern India; and the answer he received from that truly great philosopher, went far to confirm the report.

We have likewise an instance of Darwin describing the baranetz lamb, long after it had been ascertained that there was no creature of that description,—for errors of long standing can only experience a lingering death.*

"Those who reflect on the above extravagant conceits and errors that were formerly entertained respecting plants, will not implicitly adopt the opinions of the ancients respecting Varieties. And why should they? The knowledge of Varieties is not a battle that was fought, or a temple that was built, two or three thousand years ago, that the testimony of Theophrastus, of Virgil, or of Pliny, respecting it, should be deemed conclusive. It is a subject con-

* As some account of the Baranetz may not be unacceptable, I subjoin the following particulars from the Memoirs of Peter Henry Bruce, Esq. who, in the year 1723, visited Astrachan, where this supposed monster was reported to grow:—

"I had both heard and read of an herb that grew about Astrachan, called baranetz, or lamb-skin, which was alleged to grow upon a single stalk, in the shape of a lamb, and which, when ripe, was covered over with hair or wool; and that it consumed all the grass that grew near it; and that, when taken off, it served for fine fur for caps, or lining clothes. But as there is no such herb, I was at a loss to conceive how such a mistake could arise. However, on inquiry, I was informed that the baranetzs, or lambs, are cut out of the sheeps' bellies a little before their lambing-time, their skins being then in their greatest beauty, with the hairs lying in short, smooth, pretty curls, and of different colours, as dark and light greys, black and white. The dark grey are the most valuable, and are sold as high as ten shillings sterling a-piece, and the black at five; the light grey and white at half-a-crown. The Nagayan Tartars, as the Indians, Persians, and Russians, buy all they can produce. I bought by commission, for Count Bruce and General Le Fort, of the best kind, to the value of two hundred rubles."

cerning which every man has an opportunity of informing himself by personal observation. The cultivator has only to consult his own experience of the Subspecies or Varieties that belong to leguminous and graniferous species, to discern their true character. From them he will learn, that Subspecies or Varieties are not more variable than the original species of which they are the varieties; that their distinctions, though secondary, are not less fixed than distinctions that are primary; and that the character hitherto assigned them is inapplicable. If he has attained eighty years of age, and has been a strict observer of the mutations incident to the Varieties of graniferous and leguminous species, it is probable he never once witnessed, during his whole life, the production of a new Variety, or a Variety produce any other than itself. If he has, he may rest assured that he has seen that which has not been seen by one cultivator amongst ten thousand.* His long experience, it may be presumed, has rendered him familiar with giant plants; and it may have been his practice, as it is of cultivators in general, to pull all such plants out of the ground, as degenerate Varieties: or he may have made trial of them, and found that they in nowise tended to the deterioration of a Variety, but that they were the same, and, upon re-

* It would not appear that intermediate Varieties, or those generated by the sexual commerce of others, are ever produced amongst those of the leguminous and graniferous kinds that are in general cultivation, independent of assistance from man. Hence the rare occurrence of new Varieties amongst plants of that description. But though they do not produce intermediate Varieties of themselves, it is well known that certain Sub-varieties of the pea, possessing considerable merit, have been produced by the assistance of man.

newal from seed, their difference in magnitude would disappear. He may have frequently seen plants that belong to the same variety, differ in the colour of their flowers,—which distinction, like that of procerity, when unassociated with other distinctions, did not admit of a renewal from seed: but he never witnessed a tendency in the Subspecies or Varieties of a leguminous or a graniferous species, to reassume the primitive character of the species whence they sprung, or that they were more prone to change than species of primary origin.

SUBSPECIES.

CLASS II.

ANNUAL AND BIENNIAL SUBSPECIES WITH EXPOSED FRUCTIFICATION.

AMONGST the Subspecies or Varieties of the first class, permanence of character prevails: all are endued with the power of transmitting their distinctions to posterity; and all, with the exception of the varieties of the *Ficus carica*, appear to retain that power in like perfection. But amongst the Varieties of this class, we do not find the like permanence, and the reason is,—all that have sprung from the same-species are liable to mix when growing in proximity; and were it not that cultivators are perfectly aware of this circumstance, and are in the practice of planting the kindred Varieties of this class at a distance from one another, in order to prevent their intercourse, the majority would certainly be deprived of the power of transmitting their respective distinctions to posterity; or, in other words, they would cease to be the same Varieties.

Did cultivators permit the promiscuous intercourse of brocoli, cauliflower, cabbage, greens, savoys, and other

varieties of the *Brassica oleracea*, the consequence would be that every one of those varieties would cease to exist, and their place would be supplied by numerous intermediates or mongrels of inferior quality. The maintaining of the varieties of this and the other species of *Brassica*, *Raphanus*, *Beta*, and *Cucumis*, in a state capable of transmitting their distinctions to posterity, is certainly not a recent discovery; and though we are ignorant of the precise period when cultivators attained that knowledge, yet it would appear that the planting of the kindred Varieties of this class at a distance from one another, in order that they might retain their respective distinctions, must have been practised long before the days of Linneus, or that period when the sexual commerce of plants became generally known. This much we know, that certain varieties of the *Brassica oleracea* have been in the world for upwards of two hundred years,—a circumstance which goes far to prove that in former times cultivators were not ignorant of the means to be observed in maintaining the varieties of that species in a state capable of reproducing themselves from seed: for, with the exception of the varieties that belong to the *Brassica Rapa*, none are more prone to mix; and, as none require a greater distance to be kept between them when in flower, it is not to be supposed that they could have existed till now, had not means been used to prevent their intercourse.* Be this as

* The maintaining of certain Varieties in a state capable of transmitting themselves to posterity, by men who were ignorant of the existence of the sexes in plants, may appear incredible to some. But when we reflect on experience having taught the illiterate Arabs to collect the flowers of the *male dates*, and to tie them to the *female dates* in spring; and of its having taught the Copts, or

it may, it is now fully ascertained that they only retain the power of transmitting themselves to posterity,—or, in other words, they only continue to be the same Varieties,—when debarred all sexual communication: and in this respect they are the same with all other Varieties of the class to which they belong.

As the annual and biennial Varieties, of which this class consists, only differ from the annuals and biennials of the first class, in their having exposed fructification,—and as they only differ from the Varieties of the third class, in consisting of individuals or plants that flower once, and not for a number of years in succession; it is evident, therefore, that all difference between them and Varieties of the first class, with respect to stability or permanence of character, must proceed from their having exposed fructification; as also that all difference between them and the Varieties of the third class, with respect to permanence, must proceed from their being annuals and biennials. When they fail to reproduce themselves from seed, and thus differ from the Varieties of the first class, it is not owing to an existence in them of an inherent proclivity to change: it is simply the result of their sexual intercourse with their kindred Varieties that are growing in proximity; and when the cultivator discovers that his endeavours to maintain them in a state

Egyptians, to plant a greater or less number of the male plants of that species along with the females, in order that fruit may be produced in greater abundance, we will cease to be surprised at its having taught the inhabitants of this and the other countries of Europe, that it was necessary to keep certain Varieties apart, when in flower; and that it was only by keeping them apart, that it was possible to cultivate them with success.

capable of renewing themselves from seed, are crowned with success, while the like endeavours to maintain the Varieties of the third class in that state prove ineffectual, it is merely because their more frequent renewal from seed prevents that more complex and incongruous union of distinctions which characterize the majority of intermediates that are generated by the sexual commerce of perennial Varieties.

Upon the whole, the Varieties of this class are distinguished from those of the first class, by their producing intermediate Varieties; while they are distinguished from those of the third class, by the association of the marks, properties, or qualities, which characterize the intermediates they produce, being less incongruous and involved. Indeed, experience testifies that the incongruous marks or distinctions which characterize the majority of the intermediate Varieties of this class upon their first appearance, are soon reduced by seminal renewal,—an occurrence which shows that nature is ever exerted to maintain a simplicity of character.

It may be of some importance to remark, upon the first appearance of new Varieties in this and the following class, that their origin, in most instances, may be ascertained by observing whether they are produced singly or in numbers. When produced singly, the probability is that they derive their origin from culture; but when they appear in numbers that are the same, or when they appear in numbers that differ from one another, as also from the Variety or Species whose seedlings they are, then may we rest assured of their being intermediates. With respect to polyspermous plants, this rule may be looked upon as unexceptionable;

and though it is not impossible that instances may occur of intermediates being produced singly by the sexual intercourse of plants that produce their seeds singly, yet instances of their being so produced, are certainly rare.

SUBSPECIES.

CLASS III.

PERENNIAL SUBSPECIES WITH EXPOSED FRUCTIFICATION.

THE farmer sows his different varieties or subspecies of wheat, oats, peas, beans, and barley, without the least solicitude for their safety as varieties; because he knows for a certainty, that, if they grow and arrive at maturity, they will reproduce themselves. The gardener, by placing a favourite variety of melon, gourd, or cucumber, in a situation so as to prevent its intercourse with its kindred varieties, knows that by so doing he will maintain it in a state capable of transmitting itself to posterity. But he who cultivates the different varieties of apples, pears, peaches, plums, grapes, and cherries, regards them as naturally incapable of reproducing themselves from seed. When he sows the seed of an esteemed variety of apple or pear, that seed does not produce the same variety, but a number of varieties, not two of which are the same. If he even procures seed from a golden pippin apple, or a burgamot pear, that grows at a distance from all other varieties of the species, he nevertheless fails in the attempt. Convinced of his inability to effect their renewal from seed, and unable to discern the

causes of their inconstancy, he readily believes in all that has been affirmed concerning their instability; and, in conformity to the general received opinion, he concludes that all plants of that denomination are naturally unstable and prone to change. But with all due deference to his opinion, and also to the opinion of men, of whose superior knowledge and attainments no one can entertain a doubt, it is imperative to state that the conclusion is unjust. The Varieties of the first class, or those with secluded fructification, agreeable to what has been already observed, reproduce themselves with constancy, independent of any assistance from the cultivator. The Varieties of the second class, or those of annual and biennial duration, and that have exposed fructification, reproduce themselves with the like constancy when debarred all sexual communication. It is only the Varieties of the third class, therefore, or such as are perennials, and have exposed fructification, that baffle the art and skill of the cultivator to effect their renewal from seed.

Some may be disposed to conclude that all perennial Varieties are naturally incapable of perpetuating themselves. But this is not the case. On the contrary, the different Varieties that belong to the perennial and primary species of *Trifolium*, *Cytisus*, *Phaseolus*, and others that have secluded fructification, reproduce themselves with the like constancy as the species of which they are the varieties,—a satisfactory proof that the instability of perennial Varieties, with exposed fructification, proceeds from their sexual intercourse. Indeed, amongst perennial Varieties with exposed fructification, that have been at any time exposed to an intercourse with their kindred Varieties, none are found to possess the power of reproducing themselves from seed.

When a Subspecies or Variety that belongs to this class is removed to a distance from its kindred Varieties, and when it is found to produce a mixed offspring after its removal, there can be little doubt that this produce is the effects of its previous intercourse. For as Varieties with secluded fructification,—annual, biennial, and perennial,—reproduce themselves with constancy; and as annual and biennial Varieties reproduce themselves with the like constancy when kept apart; it is reasonable to conclude that Varieties of perennial duration, and that have exposed fructification, would reproduce themselves with the like constancy when kept apart, were they not deprived of that power prior to their separation. Yet we must not conclude that distinctions which accompany Varieties of the intermediate kind from seed, are always such as the Varieties possess the power of transmitting to their progeny. On the contrary, there are frequently instances of Varieties being produced, that are unable to retain certain of the distinctions with which they at first appear, much less to transmit them to posterity. It may be affirmed, therefore, that in some cases the instability of the characteristics of the Varieties of this class proceeds from their being intermediates of this description; though there are good reasons for asserting that it more frequently proceeds from their sexual intercourse prior to their separation, than from the incongruity of their natal distinctions.

As the permanence of the characteristics of a Variety depends upon their intimate union, and as it is natural for some Varieties to be late, and others early—for some to be tall, and others dwarf—for some to produce white flowers, and others red, blue, purple, &c.;—it is obvious that their

intercourse would frequently, if not invariably, produce anomalous and unstable intermediates, were it not for the unremitted efforts of nature to maintain a simplicity of character, by preventing an incongruous association of distinctions. Some are apt to conclude, from the intimate affinity that exists between Varieties of the same species, that the intercourse of any two would invariably give being to a third, partaking of all the distinctions of its parents. But this is not the case: for although an intimate relation exists between Varieties of the same species, yet experience testifies that their distinctions are frequently such as do not admit of an union in the same individual. Hence, when an intercourse takes place between Varieties of this description, certain of their distinctions are not transferred to their joint produce, but experience a reduction or an assimilation.

It is by reason of the affinity of certain distinctions, and the disparity of others, that intermediates, produced by the intercourse of the same Varieties, so frequently differ; and that a Variety of six feet, and another of three, instead of producing intermediates of a mean height, sometimes produces those of eight and nine feet in height; and it is likewise the obvious cause why the five seeds of an apple or pear, that have been produced by a variety long exposed to an intercourse with its kindred varieties, yield five distinct varieties, instead of five that are the same.

That a Variety should reproduce itself with constancy, when debarred an intercourse with its kindred Varieties, and produce intermediates when exposed to an intercourse, is that which we are naturally led to expect; but that it should lose its singleness of nature, and be rendered for

ever after incapable of reproducing itself, by reason of its intercourse, may appear incredible to some: yet attentive observation will not fail to prove that such is the case.

Farther, to some it may appear equally incredible that a plant should retain its exterior form and appearance, when it becomes so mixed as to be capable of producing thousands of distinct Varieties: yet experience and observation alike evince the fact. Indeed, by the intercourse of different Species and Subspecies, that are of perennial duration, effects the most extraordinary are produced.

Instances sometimes occur of Species, or Varieties, gaining partial possession of the bodies of one another, by their sexual intercourse, and in that state continuing to retain their distinct properties, as we perceive scions to do when ingrafted. Such instances, however, are very rare, and probably never take place between Varieties that belong to the same Primary Species: for although it is an occurrence that evinces an intimate affinity between the plant that confers its distinctions, and that which is the accipient, yet the existence of the conferent in an entire state, would induce us to conclude that there exists a disparity between them which we cannot reasonably suppose to exist between Varieties that have sprung from the same Species.* But whether they may have been originally the

* The peach and the nectarine are generally supposed to be varieties of the same species; but as there have been repeated instances of the peach appearing in an anomalous state, by reason of its intercourse with the nectarine, the probability is that they are originally distinct. The seeds of the peach, so far as I can learn,

same or different, the occurrence is certainly a manifest proof that their intercourse, though sufficient to effect their aggeneration or corporeal union, is nevertheless insufficient to effect that still more intimate, though frequently incongruous union of distinctions that are essential to the existence of intermediates.

The remarkable phenomenon which we have just noticed is an ocular proof of the prevalent cause of instability amongst nearly allied Species and Subspecies that are of perennial duration. It shows that the effects of the sexual intercourse of perennial plants, that are nearly allied in nature, is not confined to their joint produce, but extends to the plants themselves.

To contend that the intercourse of nearly allied perennials must visibly change them as often as it takes place, or to contend that they are never affected but when visibly changed, would be contrary to that which experience teaches us to believe. In the preceding part of this work, it has been exemplified that when plants are removed from the soils, situations, and climates, in which they were produced, they in general retain the peculiarities they inherit from the said soils, situations, and climates, during their annual, biennial, or perennial existence; and it has also been exemplified that variegation, impletion, and similar affections, when from seed, are in general such as plants continue to retain so long as they live. With respect to the marks

have never been known to produce a variety of the nectarine, nor the seeds of the nectarine a variety of the peach; nor has intermediates been produced by their intercourse.

which characterize individuals that are Subspecies or Varieties, the case is similar,—the distinctions they inherit from seed, whether specific or incongruous, being in most instances the same that continue to distinguish them during their existence. When specific, they are naturally permanent, though not immutable; and even when incongruous, experience testifies that they are seldom supplanted during the existence of the individuals which they distinguish. Yet it is certain that plants are often virtually changed, while they maintain the same material form and appearance.

Thus, when a new Variety is produced by culture and other conficient causes, the plant from which that Variety was obtained, cannot be otherwise than virtually changed. If it is annual or biennial, or such as only yields seed once during its existence, all trace of its unseen and acquired properties perish with it. But if it is a perennial, and continues to yield seed for a number of years in succession, then will it continue to produce a mixed offspring. Hence it is obvious, that inconstancy or instability may sometimes originate in a plant that is perennial, even when debarred all sexual communication with other plants that are nearly allied to it in nature; yet, as has already been observed, we may reasonably conclude that the more prevalent cause of instability is the sexual commerce of plants that belong to different Varieties.

In no class of Varieties, annual, biennial, or perennial, with secluded or exposed fructification, can the production of new Varieties, by culture, be regarded otherwise than as an extremely rare occurrence. Hence we may presume that it is rare the instability of perennial Varieties proceeds

from the production of new Varieties by culture: yet that it is occasionally produced in that way, admits of no doubt. The instability of the Subspecies or Varieties of the *Ficus Carica*, or cultivated fig, may be considered as a proof of this.

These remarks evince that the instability so prevalent amongst the Subspecies or Varieties of this class, may proceed from culture or from their sexual intercourse;—that the intermediates, produced by their intercourse, may or may not possess the power of transmitting to posterity the distinctions which accompany them from seed, or which distinguish them upon their first appearance;—and that, by their sexual intercourse, they are virtually, if not in some instances visibly and materially changed.

This last-mentioned occurrence is not only remarkable as an ocular proof of plants, that are nearly allied in nature, being permanently affected by their intercourse, but also of the transmutation of the sexes. But, truly, of the nature and extent of the effects produced in plants by their sexual intercourse, much remains to be discovered,—much which only time and strict investigation can reveal, and much that may prove highly useful when known. Of the effects of their intercourse upon their health, the quality of their produce, their productiveness, &c. our knowledge is very limited. It is not improbable, however, as the majority of the Subspecies or Varieties which belong to this class are readily propagated by artificial means, and as they are permitted to mix promiscuously, that the changes they consequently experience may be more considerable than is generally supposed. Indeed, in some cases, the changes they

experience may be even great, without our being able to detect them, far less to estimate their extent.*

As this class of Varieties consists principally of intermediates or mongrels, which are frequently produced in numbers by the same plant, we therefore find them to be exceedingly numerous. Those of the apple alone, outnumber all that belong to the first class, and probably all that belong to the second. For as the Varieties of the first class have secluded fructification, and are debarred an intercourse,—and as the cultivator finds it his interest to debar the intercourse of those that belong to the second class, the increase of intermediates of these two classes is thereby prevented: but as he is enabled, by artificial propagation, to transmit perennial Varieties to posterity, he permits the unlimited intercourse of the Varieties of this class, and hence the innumerable intermediates with which it abounds.

Some private collections, at this present day, consist of from two to three hundred varieties of the apple, and nearly as many of the pear: varieties of the gooseberry are exceedingly numerous, and those of the grape are equally so. In France alone, M. Chaptel, when minister of the interior,

* The properties which in an eminent degree enhance the value of the Varieties that belong to this class, are in many instances such as can neither be delineated nor depicted, and only admit of a very imperfect description. The flavour or aroma of fruits, for instance, is a property which we possess no correct means of describing, yet it constitutes their principal excellence. With regard to that particular, therefore, the deterioration which some choice varieties of fruit may have sustained, from being long exposed to an intercourse with inferior varieties, may be great, and yet unknown to us.

collected fourteen hundred varieties of the last-mentioned species; and should the curiosity of any man induce him to make a similar collection of the varieties of the apple that are to be found in different parts of Great Britain, they would even outnumber the grapes of France. Those who are desirous of obtaining new varieties of apples, grapes, &c. may produce any number from seed. From the five seeds of the same apple, they may obtain five different varieties; and, from a thousand apples, they may obtain five thousand. But he who studies improvement, is only desirous to obtain those of real merit or excellence, well knowing the unlimited increase of intermediates to be an evil.

Though by far the greater number of Varieties that belong to this class, are of the intermediate kind, and incapable of reproducing themselves from seed, yet they are not wholly of that description. Some, like those of the *Anethum Fœniculum*, or fennel, are known to reproduce themselves with constancy; others, like those of the *Ribes rubram*, or currant, only reproduce themselves occasionally; while others, like those of the *Pyrus Malus*, or apple, seldom or ever reproduce themselves. For it is to be observed, that when Varieties that have sprung from the same species are few in number, and when it is the practice to plant them apart and to propagate them from seed, as is the case with the different varieties of fennel, then will they severally reproduce themselves; and when few in number and minutely distinct, as is the case with those of the currant, then will they sometimes reproduce themselves, though no care has been taken to prevent their intercourse; but when they are numerous and allowed to grow in proximity, and when it is

the practice to propagate them from buds, scions, and the like, as is the case with those of the apple, then is it impossible to obtain them a second time from seed.

From the preceding survey of Subspecies, or Varieties of their Species, it is obvious, that such as derive their being from culture, are endued with the power of reproducing themselves from seed;—that, by their sexual intercourse, intermediate or mongrel Varieties are produced, which may or may not admit of seminal renewal;—that Varieties of the intermediate kind are in proportion to those produced by culture;—that the increase of intermediates tends to produce instability of character amongst the Varieties of a species;—that the more exposed the organs of generation are, in Varieties of the same species, and the greater the number of Varieties that are permitted to grow in proximity, the more numerous will be the intermediates;—that the less exposed they are, and the fewer the Varieties that are permitted to grow in proximity, the fewer the intermediates;—and that, when the seclusion of the sexual organs is complete, intermediates cease to be produced, while the Varieties produced by culture, continue to transmit their respective distinctions to posterity.

These comprise the leading particulars which have been more or less satisfactorily explained in the course of the preceding pages. Yet there are other phenomena therein mentioned, that highly merit attention, and which the subjoined Essays are intended in some measure to elucidate.

ESSAYS

ON VARIOUS SUBJECTS,

RELATING TO

SUBSPECIES OR VARIETIES.

ESSAYS.

ON THE MONADE EXISTENCE OF ACQUIRED PROPERTIES IN PLANTS.

In treating of perennial Subspecies or Varieties of their species, that have exposed fructification, it was observed that the majority are incapable of transmitting their distinctions to posterity, and that their sexual intercourse was the cause of their instability, or, in other words, the cause of their producing a mixed offspring. In support of this doctrine it was observed, that, as perennial Varieties with secluded fructification reproduce themselves with constancy, by reason of the structure of their flowers preventing their sexual intercourse, the inability of those that have exposed fructification to reproduce themselves, arose from their intercourse; and it was further urged, that, as Varieties of annual and biennial duration, with exposed fructification, reproduce themselves with constancy when kept apart, the inability of perennial Varieties that have exposed fructification, to reproduce themselves when kept apart, arose from their sexual intercourse prior to their separation, and hence from the monade or unseen existence of different properties

or qualities generated by that intercourse. Now, though this evidence of the unseen existence of different properties or qualities, which plants acquire by their sexual commerce, may be looked upon as conclusive, yet, as the doctrine is not only new to the world, but extraordinary in itself, and as to some it may seem to require further support, I shall, with a view to that effect, lay before the reader proofs of the frequent existence of the sexes themselves in a monade state: and certainly, if this can be satisfactorily proved, no reasonable doubt will then be entertained, of the similar existence of distinctions that are generated and transferred by their intercourse.

In all vegetables, the general characteristic of the sexes is, that the organs of generation are deciduous; and that, in the majority, the male and the female organs are on the same plant. Of species that have their male and female organs on the same plant, some have them in the same flower, and others in distinct flowers: the former are termed *hermaphrodite* species, and the latter *monœcious* or *androgynous*; while species that have their male organs on one plant, and their female on another, are termed *dioecious*. There are species, however, which do not strictly belong to either of these denominations, inasmuch as they have male fructification on one plant, female on another, and hermaphrodite on a third. Some there are, also, with female fructification on one plant, and hermaphrodite on another; while others have male and hermaphrodite flowers on one plant, and female on another: so that there is scarcely a position in which we can imagine the sexual organs to exist, in which they are not found to exist in some one species or other. But this is not all: in addition to the varied states

in which the sexes visibly exist, they frequently exist in a monade or unseen state, and in that state enable plants to transmit the species to posterity.

Of the existence of the male sex in a monade state, we have a most convincing proof in plants, apparently female, transmitting the species to posterity when debarred an intercourse with such as are furnished with male organs. The fertility of plants of this description, under such circumstances, can only proceed from an internal cause, and that cause can only be the male in an unseen state. Either this must be allowed, or the existence of the sexes in vegetables treated as chimerical. But there is no reason to believe that the reproductive power of plants that only possess the female organs of generation, in the least militates against the doctrine of the sexes; for when plants of this description produce perfect seed of themselves, it shows that they are not solely female, but male and female. It would be absurd to suppose that plants strictly female could of themselves transmit the species to posterity by means of seed; nor would it be less absurd to suppose that male plants, or that sexless plants, possessed that power; and though we are apt to conclude that the sexes do not exist but where the organs of generation evince their existence, yet facts prove the contrary. There are even good reasons for asserting, that thousands of species exist without either male or female organs, that are nevertheless male and female. The most minute inspection has failed to discover either the male or the female organs in cryptogamous species, nor is there any reason to believe that they possess them; yet the fact of their producing seed, evinces the existence of the

sexes. But as some doubts are entertained of the *propagines* or seeds of *cryptogamous* plants being perfect seed, I shall not insist upon the evidence they afford, but refer the reader to *hermaphrodite* and supposed *diœcious* species, for proofs of the doctrine now advanced.

It was observed in a preceding part of this work, that in species strictly *diœcious*, exposed fructification is indispensable to the commerce of the sexes and perpetuation of the species. This, indeed, is so very obvious, that no one who believes the sexes to be intended for the propagation of the species, can think otherwise. But upon referring to species which, in botanical works, are described as *diœcious*, we find some that have their male and female organs so placed, that the external commerce of the sexes cannot readily take place; and we even find species with secluded fructification, so that their external commerce cannot possibly take place. No man, I presume, who has examined the fructification of the *fig*, can believe that fig-trees are distinct male and female: at least he must, upon reflection, be compelled to allow that, if they are such, it must be without relation or connection,—because, in the fig, the flowers are inclosed within the fruit in a manner that plainly indicates to the most superficial observer, that if the sexes exist in distinct plants, their intercourse cannot possibly take place, otherwise than by the intervention of artificial or foreign aid. I acknowledge that the appearance, in the different species of the fig, of the male and the female organs on distinct plants, would seem to justify the conclusion of their being *diœcious*; but their secluded fructification is a satisfactory proof that every fig-tree must possess the means of reproduction within

itself; and if not, that it can only exist male for itself, or female for itself,—or in other words, male or female for neither end nor purpose.*

* There is no reason to suppose that botanists have erred in describing the order or disposition of the sexual organs in the fig. On the contrary, the description they have given, may be considered as confirmed, in every particular, by the most careful observation. They agree that it is a *polygamous* species, and that it produces male flowers and female flowers, which are inclosed within the same receptacle or fruit. Now, according to this, the fig is a *monœcious* species, and belongs to the class *Polygamia;* but as the majority of cultivated fig-trees are apparent females, or such as do not produce male flowers, while there is another sort, called *Caprificus*, that only produces such as are male, all botanists, since the days of Linnæus, have therefore been led to describe the fig as a *diœcious* species of that class; and in this they have erred. For although the fig, from the disposition of the sexual organs, may appear to be *diœcious* in some instances, it does not uniformly appear as such, but frequently as *monœcious;* while its secluded fructification is a manifest proof of its being a species of the latter description,—that is, a species consisting of individuals that are severally endued with the power of reproduction.

In the south of Europe, where figs abound, a singular practice at one time existed, called the *caprification* of figs. It consisted in placing early or spring figs in the vicinity of the late figs, in order that a species of gnat, which frequented or lodged in the former, should enter the latter when in flower, and, by moving amongst the male flower, effect the diffusion of the *pollen*. But it is very questionable if those gnats assisted to fertilize figs wherein the male and female organs were inclosed, and it is scarcely possible they could in any wise assist to effect an intercourse between the sexes of distinct fig-trees. Indeed, the practice of caprification having been found to be injurious, rather than beneficial, in consequence of the gnats depositing their ova in the fruit, it is now exploded.

Of species like those of the fig, that are found with their male and female organs on separate plants, it is probable there is none either strictly male or strictly female: for although appearances would induce us to believe that they are distinct male, female, and hermaphrodite, yet the power the apparent females possess of transmitting the species to posterity, proves the existence of the male in a monade state, and shows that such plants, though apparently female, are in reality hermaphrodite. That the apparent females belonging to species of this description, are far more productive when growing in proximity to the hermaphrodites and apparent males, than when growing at a distance from them, is a fact confirmed by experience. But it is only in species with exposed fructification that this occurs: for in species like those of the genus *Ficus*, or fig, the sexes might just as well exist in distinct planets, as shut up in distinct receptacles, upon distinct plants.

But it is not only the apparent females of species that have their male and female organs on distinct plants, and occasionally upon the same, that afford instances of the power of reproduction, in plants the fructification of which is wholly female. The females belonging to the majority of species that are accounted strictly *diœcious*, or such as are invariably found with their male and female organs on distinct plants, possess the like power. Of this, the females of the *Humulus Lupulus*, (hop), *Empetrum nigrum*,* (crow-

* In some parts of Britain, where the *Empetrum nigrum* is found growing in its wild state, the most diligent search is unable to discover a plant that possesses the male organs, and yet the apparent females annually produce fruit and perfect seed in abundance.

berry), *Cannabis sativa*, (hemp), *Mercurialis perennis*, (mercury), and *Spinacia oleracea*, (spinage), furnish the most satisfactory proofs. It is even probable that the apparent females of all species accounted *diœcious*, are capable of transmitting the species to posterity; and though some may produce seed but sparingly, when debarred an intercourse with the males, yet others, like those of *Cannabis*, *Empetrum*, and *Spinacia*, will be found to yield it in abundance. I never knew an instance of barrenness in the females that belong to any of the species just mentioned, by reason of their separation from the males; yet I have frequently known them to produce abundance of perfect seed, when many miles distant from any male or apparent male of their species.

It is generally believed that the fertility of plants apparently female, when growing at a distance from such as are furnished with male organs, arises from the *pollen* of the latter being conveyed to them by winds and insects. But although the transfer of the *pollen* by winds and similar agency, must frequently happen, there is no reason to believe that it is carried to the distance of miles. On the contrary, we know for a certainty, that plants between which there exists the most intimate relation, and that mix readily when growing in proximity, as those of the *Brassica Rapa* and others, seldom or never mix, but retain their distinctions when growing at the distance of only two or three hundred yards;—a circumstance from which we may reasonably infer, that when miles intervene no communication whatever can take place. It may be observed, likewise, that the fertility of the apparent females is the same at all distances from the apparent males, except when grow-

ing in their immediate vicinity,—a satisfactory proof that they do not derive their fertility from them, unless when growing in their immediate vicinity.

That plants with female fructification should of themselves produce perfect seed, is decidedly at variance with the opinions that are generally entertained of them. Yet by the following, or a similar experiment, the fact of their being endued with that power is placed beyond all doubt:—

About the beginning of February, sow a few seeds of the *Cannabis sativa*, or hemp, in a pot, and place that pot in the hothouse. Let the young plants, the produce of that seed, enjoy a sufficiency of light and heat, and water them occasionally. Plant out the apparent females into the open ground about the beginning of May, taking care to destroy all the males, which may be readily distinguished from the females at that time, by their diminutive size. By this treatment, the females will come into flower about the middle of summer, and by the beginning of autumn they will have produced you perfect seed, from which you may obtain young plants that same season: this seed they will produce without having produced either a *stamen* or an *anther*.

No one who reflects upon the result of this experiment, can believe that the fertility of the apparent females arises from their intercourse with the plants that produce the male fructification. For if the experiment is performed in Britain at the time above-mentioned, we may presume that no male plants are then to be found in flower, that are not some thousands of miles distant.

Many instances might be referred to, of the power of reproduction in plants that only possess female fructification; but a single instance is sufficient to attest the fact, and a single experiment, like that of the preceding, will go farther in dispelling doubts than a volume of arguments.

But as some may not have it in their power to satisfy themselves by means of an experiment, I shall mention an instance of a well known species, that will, in general, afford the information required, upon bare inspection:—it is that of the *Thymus vulgaris*, or common garden thyme.*

When this species is raised from seed, amongst twenty plants so produced, we shall scarcely find two that possess the male organs; and when propagated by slips, which is the more common practice, it frequently happens that whole plantations are formed of plants that are apparently female. And as gardeners are in the habit of giving and receiving slips, when they lay down plantations of herbs, a plantation of this description, when once laid down, becomes the parent plantation of others that are similar; and thus extensive

* It is a singular fact, that notwithstanding the greater number of plants of this well-known species are apparently female, their being such should have hitherto escaped observation. It has even been observed by different botanists, that, amongst *Didynamous* species, none had been found with the male and female organs on distinct plants; nor have I ever found a plant of any species of thyme, with its fructification wholly male, though by far the greater number of plants, of the *Thymus vulgaris*, *citriodorus*, *serpyllum*, and *lanuginosus*, have them wholly female. Indeed, all the plants of the last-mentioned species, which I have as yet seen, have been of that description.

tracts of country are frequently found to possess no other sort. In some parts of Britain, plantations of apparently female thyme are to be found five, and even ten miles distant from any other plant of the species that produces either a *stamen* or an *anther*; and if such produce perfect seed, as they are invariably found to do, who then can entertain the least doubt of their being endued with the power of reproduction?

It is worthy of remark, that apparently female thyme plants are far from being so productive as plants that have their male and female organs in the same flower: numbers of the flowers prove abortive, and it is rare that more than one seed succeeds a flower.* But when planted contiguous to the hermaphrodites, they become more productive, and two, three, and even four seeds, will then succeed each flower: and it is farther worthy of remark, that plants retain the fertility which they have acquired in this way, or at least continue to produce seed more abundantly than before.

Thus, in a plant the fructification of which is wholly feminine, we have a proof of the unseen existence of the male in a degree barely sufficient to produce fertility,—of its co-operation in producing an increased degree of fertility,—and of its having acquired an additional power, by which the plant it inhabits continues to bring forth more abundantly. Now, this last-mentioned circumstance shows

* The flowers of thyme plants that are furnished with male and female fructification, are larger than the flowers of the apparent females: their styles are shorter, seldom bifid, and four seeds commonly succeed a flower.

that a plant may not only acquire a permanent fertility, but different properties or qualities, by its intercourse with different Varieties of its species: for should it derive its fertility from an intercourse with a different Variety, it will at the same time acquire the properties or qualities of that Variety, which, existing in conjunction with its own, will cause it for ever after to produce a mixed offspring. It is thus perennials with exposed fructification, that may at any time have been exposed to an intercourse with Varieties, or Species nearly allied in nature, acquire different properties or qualities; and it is because Varieties with secluded fructification are debarred an intercourse,—and Varieties with exposed fructification, of annual and biennial duration, only flower once, that they are prevented from becoming the similar receptacles of monade or unseen distinctions.

Though the preceding proofs of the monade existence of the sexes, and distinctions generated by their intercourse, are deduced from apparent females belonging to species that have their male and their female organs on distinct plants, and species that have them on distinct plants and occasionally on the same, it is not because other proofs are wholly wanting, but from their affording the most satisfactory proofs, that they have been adduced in evidence. It would be unreasonable to expect a proof of the existence of the female in a monade state, similar to that obtained of the existence of the male; because, before a plant apparently male (though in reality male and female,) can possibly produce seed, a visible change must take place, by which it assumes either the characteristics of a hermaphrodite or a female. The fertility of a plant apparently female, takes place independent of either an accession or change of parts;

but the fertility of a plant apparently male, necessarily implies a change in its organs of generation, prior to its producing seed.

The producing of perfect seed, by plants that only possess female fructification, is not uncommon; but it is rare that plants possessing only male fructification, experience a change that enables them to transmit the species to posterity. Indeed, of the numerous changes incident to plants, this, we may presume, is a transmutation most rare.*

Farther, though the proofs obtained of the internal or monade commerce of the sexes, in species that have their male and female organs on the same plant, are more rare than in species that have their male and female organs on distinct plants, they are not less satisfactory. Nor is the rareness of such proofs a circumstance at all surprising, when it is considered that the only means by which we can ascertain the fact, is by depriving the plants of their stamena and anthers at that period when the most ample provision exists for the propagation of the species, by the ordinary intercourse of the sexes. That the majority of plants prove abortive, when thus treated, is a fact sufficiently confirmed

* In the *Humulus Lupulus*, or hop, and in the *Fragaria elatior*, or hautboy-strawberry, instances of the transmutation of the sexes are not infrequent; and in making plantations of the latter, it has been strongly recommended by some, to plant the males at regular distances along with the females. But the preferable method is to plant none but females. They will yield abundance of fruit and perfect seed, independent of the presence of the males; nor will it be long before some of those supposed females are transformed into males.

by experience. Indeed the general belief is, that no plant, when deprived of its male organs and debarred an intercourse with others, can produce perfect seed. But this is not strictly the case. On the contrary, if a plant of the *Zea*, or Indian corn, is deprived of its male flowers, prior to the appearance of its filiform *styles*, it will nevertheless produce perfect seed, though miles distant from any other plant of the species. It is evident, therefore, that though the majority of plants fail to produce seed, when deprived of their male fructification, others retain that power.

On the whole, the preceding remarks satisfactorily evince the bonade existence of the male sex in plants that are apparently female, and also the similar existence of different properties or qualities which plants may acquire from their sexual intercourse. For, agreeable to what has been observed, if a plant acquires additional fertility from being impregnated by a different variety of its species, it will acquire different properties or qualities at the same time.

ON MAINTAINING SUBSPECIES IN A PERMANENT STATE.

FEW subjects merit the attention of the cultivator more than that of maintaining valuable Varieties in a state capable of transmitting their distinctions to posterity. For could it even be proved that artificial propagation possesses all the advantages of natural propagation,—and that a Variety maintained by artificial means, was in every respect as good, at the expiration of a thousand years, as when first raised from seed,—the protecting of valuable Varieties from an intercourse with others, would nevertheless be highly worthy of attention: for whatever tends to reduce or assimilate the distinctions of succeeding Varieties, must retard improvement.

If, for instance, a cultivator possesses a variety of melon or cucumber, which he prizes for its superior earliness, he is perfectly aware that by an intercourse with late varieties, it will lose the property for which he esteems it; and that, instead of reproducing itself, it will produce intermediates inferior in earliness: he therefore wisely uses means to prevent an occurrence, which to him might prove highly injurious. But when he possesses a variety of apple or pear, which he prizes for its superior earliness, he allows it to mix with varieties of every description, because it, or rather a

good semblance of it, admits of artificial propagation. He never attempts its renewal from seed, nor sows its seed, but with a view to obtain new varieties. But if planted in the vicinity of late varieties that belong to the same species, he has no right to expect an earlier variety, or even one so early: he might as reasonably expect that an early variety of melon or cucumber, when exposed to an intercourse with late varieties, would reproduce itself. An earlier variety, when none earlier are in its vicinity, can only proceed from a disposition in the plant to produce a new variety; and should there exist a disposition in the plant to produce a new and an earlier variety, there is every reason to believe that its proximity to late varieties would cause the new variety to be much later than it otherwise would have been.

Species that already abound with numerous intermediate Varieties, and species the Varieties of which are minutely distinct, do not admit of a further advantageous division of their properties. On the contrary, the increase of intermediates, in species of this description, is an obvious evil. Its direct tendency is the assimilation of distinctions, and the union of the most worthless Varieties with the best.*

In species that abound with numerous intermediate Va-

* Though the exertions of cultivators in this country, and indeed throughout the greater part of Europe, to obtain new and superior varieties of edible fruits, have been greater of late years than at any former period, it is only in species, the renewal of which from seed had been long neglected, and in species consisting of distinct Varieties and few in number, that their exertions have proved successful.

rieties, and that consist of Varieties minutely distinct, extension is required. Varieties are wanted that shall surpass other Varieties of their species in some esteemed property or quality. But when these are not to be obtained by the intercourse of the Varieties that are already in existence, we must wait their production by culture. But so long as it is the practice to plant Varieties of the same species together, as it is at present with those of the apple, pear, peach, plum, cherry, &c. we cannot reasonably expect that the new Varieties produced by them will greatly surpass the the old. For did there even exist in a plant a tendency to produce a Variety, that should excel all others of the species in some esteemed property or quality, that Variety, by reason of the intercourse of its parent Variety with others that are different, is liable to a deterioration while yet in embryo. Should it ever appear as a plant, no sooner is it found to indicate merit, than the impatience of its owner to ascertain the quality of its fruit, induces him to insert a part of it upon a tree that has already attained maturity; by which means the part inserted becomes wedded, in many instances, to a greater number of infirmities than it would have otherwise contracted during a century. Should this trial branch prove it a Variety of superior merit, nearly the whole plant is cut up into scions next spring, and inserted upon stocks, not two of which are the same. It is then no longer one, but a number of plants, with roots and bolls which are not their own, each deriving its support from the soil through the medium of a plant of a different variety, if not a different species, or even genus. In this state, it continues to adjust matters with its supporters, until it comes into flower, and then every gust of wind imparts to it the properties or qualities of numerous contiguous Varieties

If there is any mode of treatment calculated to deprive a Variety of its singleness of nature, and render it incapable of reproducing itself, it is certainly the preceding: it is, in fine, all that man can do, or ingenuity suggest, in order to deprive a Variety of the power of transmitting its distinctions to posterity.

Yet, however desirable it may be to obtain varieties of apples, pears, and peaches, possessing the power of reproducing themselves from seed, it is obvious that they are not to be easily obtained; while it is not less obvious, that it is impracticable to maintain numerous Varieties of the same species within the precincts of the same garden. The cultivator who might succeed in obtaining Varieties of that description, would always be in danger of having them deprived of their reproductive powers, nor would he be able to cultivate more than two or three Varieties, even in a large garden. Hence it is questionable if the advantages he might derive from having Varieties of that description, would be such as to recompense him for his trouble. Yet the subject is one that certainly merits attention. The advantages that arise from maintaining the different Varieties that have sprung from annual and biennial species, in a state capable of reproducing themselves from seed, are sufficiently obvious; and though the propagation of perennial Varieties by artificial means renders the necessity of obtaining them from seed less urgent, yet there are good reasons for asserting, that were they maintained in a state capable of reproducing themselves from seed, a material improvement would result from the practice.

The principal and most obvious advantages that would

arise from this mode of treatment, would consist in possessing the different varieties of apples, pears, and other perennials, in their original or unreduced state, and in retaining them in a state more free from disease, if not in some instances from decrepitude or a decay of nature, which artificial propagation is supposed to be unable wholly to prevent.

ON THE MERITS OF NATURAL AND ARTIFICIAL PROPAGATION.

As the majority of Varieties that are of perennial duration are mongrels, and are only propagable by extension,—that is, by grafts, cuttings, and similar means,—we are naturally led to inquire if they continue to possess, in an equal degree, the properties or qualities which plants possess that are raised from seed; and if they have a limited duration when propagated in that way, or if they ever become old and worn out with age.

On these subjects, great difference of opinion exists,—some contending for the superior excellence of natural propagation, while others strenuously maintain claims equally high in behalf of that which is artificial. Many arguments have been brought forward by the disputants in support of their opinions. Some will even have it, because willows, vines, and olives have been propagated by extension for ages, and still continue to enjoy their health and vigour, all other plants must do the same;—a sapient reason, truly. The fact is, propagation by extension is most unnatural to some plants. In certain species of *Banksia*, and *Pinus*, it either baffles the art of the propagator to effect it, or, if he succeeds, it is only with difficulty. In *Fagus*, and *Quercus*, it may be performed with ease, but the practice is neverthe-

less reprehensible, because the plants that are propagated in that manner never arrive at the stature of trees, but continue a kind of underwood. In *Pyrus*, and *Prunus*, it is easily effected, and is evidently attended with numerous advantages over that of natural or seminal propagation; but to assert that, in addition to these, it possesses all the advantages of seminal propagation, is to overshoot the truth. In *Vitus*, and *Salix*, it may be looked upon as nearly the same as natural propagation; and in all *bulbiferous* and *viviparous* plants, it is natural. Yet Nature, whose gifts are not bestowed in vain, has not failed to endue the last-mentioned description of plants with the power of reproducing themselves from seed.*

From these statements, it is obvious that the merits of propagation by extension depend entirely upon its application. In certain cases it may be practised with great success, accompanied by advantages decidedly superior to that of propagation from seed; while in others, the case is quite the reverse. Did not that most useful plant, the potatoe, admit of propagation by a division of its tubers, it would cease to be an object of general cultivation; but if beeches, hornbeams, and firs, were only to be propagated by cuttings,

* Though propagation by extension is natural to some Species and their Varieties, and though plants belonging to them might be pointed out, that are hundreds, if not thousands of years old from seed, yet that it falls short of seminal renewal, is certain. The simple fact of plants with variegated leaves, and plants with monstrous flowers, being transmitted to posterity when propagated by extension, and of their assuming their natural character when propagated by seed, plainly evinces that propagation by seed is the most efficacious and complete renewal.

layers, and similar means, the consequence would be, that in a short time we would possess timber of none of them.

That certain Species and their Varieties, become worn out, or at least worthless, when propagated by extension, is proved by experience; and though the willows of the marsh, and the *poas* of the mountain, may be thousands of years old from seed, and retain their pristine vigour, it is very absurd to conclude that propagation by extension is alike favourable to all Species and their Varieties. There are good reasons for asserting, that renewal from seed is most essential in all cultivated plants, whether of primary or secondary origin. Plants in a state of cultivation are liable to a multitude of affections, some of which tend to enhance, and others to lessen their value. When a plant, therefore, differs from others of the same Species or Variety, in a manner that renders it more beautiful or serviceable, the cultivator, by having recourse to artificial propagation, generally succeeds in transmitting the affection to posterity, when he cannot by seminal renewal. But when the affection is malific, or tends to lessen its value, renewal from seed, if not indispensable for the preservation of life, is at least necessary for health.

These remarks evince, that in some cases propagation by extension may be highly beneficial, and in others highly detrimental. So long, however, as the cultivator has his choice, he has also his skill and experience to direct him. But unfortunately, in the Varieties which at present belong to the majority of perennial species, he has no choice. If a variety of apple or pear is affected by canker, or some other distemper that cannot be remedied or removed by artificial

renewal, he must either lose that variety, or continue to propagate it by extension, with all its infirmities. This circumstance sufficiently evinces the merits of natural and artificial propagation: it proves that it is only by having command over both modes, that the cultivator can avail himself of certain obvious advantages, and avoid numerous incidental ills; while it points out, in the plainest manner, the importance of maintaining Varieties in a state capable of seminal reproduction.

That certain Varieties of fruit-bearing species are greatly impaired in health, and only retain a faint semblance of their former excellence, is generally allowed. Their deterioration, however, is by some supposed to proceed from climate; and that the return of genial seasons would restore to us, from old Varieties, as good fruit as heretofore.* Genial and ungenial seasons have doubtless existed, and in all probability will continue to exist; but I have yet to learn that there ever has been a regular routine of either, with, perhaps, the exception of the seven fertile and the seven unproductive years of Pharoah, which I believe is the only instance on record. It is rare, indeed, that more than two very warm, or two very cold, wet, or dry seasons, follow in succession. The seasons, in our day, are probably as good, and in every respect as favourable for the growth of vegetables, as any that have existed since the creation; and I cannot help hinting to those who may anticipate the return of more genial seasons, not to be too sanguine in their expectations, nor to alter their arrangements until they have some assu-

* See Williamson, Hort. Trans. iii. 291.—Speechly, Hints, 188.—Loudon, Encyc. of Gard. 689.

rance of their appearance, or, as some will have it, their *re-appearance.*

The Varieties that are supposed to have suffered the greatest deterioration, are those of the apple: but the apple, of all other fruits, appears to be peculiarly adapted to the soil and climate of Britain. Our apples are decidedly superior to those produced upon the Continent, or perhaps to those of any country in the world; and it is my firm conviction, that should the climate of Britain become warmer or colder, or experience a material change in any respect, it would be less genial to the growth of the apple than it now is.

The deterioration of certain varieties of the apple, as will appear from the facts already stated, may proceed from various causes; and that in some cases it proceeds from age, appearances would seem to indicate. "The moil," Mr. Knight observes, "the redstreak, with the musts and golden pippin, are in the last stage of decay, and the stire and fox-whelp, are hastening rapidly after them."* Thus, agreeable to that author, the deterioration is confined to Varieties that are old; but if climate was the cause, it would not be

* The nonsuch, oslin, and some well-known Varieties of the apple, might be mentioned, which, though of decided merit, are comparatively worthless, by reason of decrepitude. It matters not what kind of stock they are wrought upon, or what situation or soil they are planted in, by the time they have arrived at maturity, or rather at a state of full bearing, they evince every symptom of decay; and their fruit, which a little before might have vied in beauty with any in the orchard, is scarcely any longer to be known as the fruit of the same Varieties.

confined to either the old or the young, but would rather fall doubly severe upon the more delicate and tender. This, however, is not the case: for the Ribston-pippin, although one of our most tender apples, is nevertheless as vigorous and durable as any variety that belongs to the species.*

The observations of Mr. Knight, regarding the deterioration of the apple, appear to be well grounded. He observes (Treatise on the Apple and Pear, p. 15), "I think I am justified in the conclusion, that all plants of the same species, however propagated from the same stock, partake in some degree of the same life, and will attend the progress of that life, in the habits of its youth, its maturity, and decay; though they will not be any way affected by any incidental injuries the parent tree may sustain after they are detached from it." One thing we know, that numerous Varieties, particularly of the apple, are in a state of disease, if not of decrepitude; and as the old varieties appear to be the principal sufferers, we may reasonably conclude that the principal cause of their deterioration arises from natural decay, or injuries sustained from an unnatural prolongation of life. But though I thus far agree with the general import of the preceding quotation, I by no means acquiesce in its particular detail. A scion taken from a young tree, and inserted upon an old one, cannot be supposed to accompany the plant whence it was taken, in the progress of its life, or in the habits of its youth, maturity, and decay. Every being entering upon life, has to pass from youth to maturity,

* This variety of the apple is so tender, that, in some parts of Britain, it even requires the aid of walls to ripen its wood, and bring its fruit to perfection.

and from maturity to old age, if not prevented by extraneous causes: but when a scion is taken from a young plant, and inserted upon an old one, Nature is thwarted from her course, and the scion, instead of passing from youth to maturity, and from maturity to old age, passes from youth direct to its goal.

Some may be disposed to believe that a scion taken from an old plant, and inserted upon a young one, is again restored to a state of youth. But Nature is not retrograde: the tree that has attained an old age, has reached its last stage. If suffering from decay, you may, by pruning and other means, restore it to a state of health; and by taking a scion from it, and inserting the same upon a young tree, you may restore that scion to a state of health, and even luxuriance: but you cannot restore an old tree, or a scion from an old tree, to a state of youth. Health is not youth, nor is luxuriance. Art cannot restore to an aged holly the armature of youth, nor induce the aged ivy to climb, or to change the form of its cordate leaves, nor divest a variegated or curled-leafed plant of its variegation or crispature.* These and other affections, some of which are probably beyond the reach of detection, are unavoidably transmitted to posterity along with a plant, when propagated by extension; nor is it possible to remove or reduce them, otherwise than by renewal from seed. But as our present varieties of the apple, pear, peach, &c. do not admit of seminal renewal, it is evident that their deterioration, whether caused by age, disease, or intercourse, must continue, and in all probability increase, until, no longer worth the attention of the culti-

* See "Dependent Affections," p. 50, 59, and 66.

vator, they cease to be the objects of culture. Nature, however, is not exhausted. Varieties equally good, and even superior to any now in being, may still be produced, which, with proper care and attention, may be transmitted to posterity in full possession of their superior qualities and inherent powers.

ON THE LIMITS OF THE SEXUAL INTERCOURSE OF PLANTS.

THE extent of the sexual intercourse of plants is limited by their inherent disparity—by the structure of their flowers—by their difference in time of flowering, and by the distance that intervenes between the situations they inhabit.

In consequence of the natural disparity which exists between the majority of primary species, their intercourse is very limited. The remote connexion of species that belong to different genera, effectually precludes their intercourse, or, in other words, it prevents them from producing intermediates; and even the more intimate connexion that exists between species of the same genus, is in most cases sufficiently remote to prevent them from producing plants of that description. By the intercourse of some, however, intermediates are frequently produced, which evince the more or less intimate affinity of the species from which they have sprung, in their being stable or unstable, and fertile or sterile, in proportion.

Thus, the intermediate distinctions generated by the intercourse of the *Fragaria Vesca* with other species of the genus, are said to be so very slight that they are seldom permanent in the plants affected, but are subject to fly off.

The intermediates produced by the intercourse of certain species of *Amaryllis*, are such as retain their distinctions during their existence, though, like the majority of other mules, they are in general barren. The intermediates produced by the intercourse of certain species of *Rheum*, are barren like those of *Amaryllis*; yet some that are produced by the intercourse of other species which belong to that genus, have perfect fructification and reproduce themselves from seed. The majority of the intermediates that have sprung from the different species of *Pelargonium*, as has been already observed (p. 113), are such as yield seed in abundance, and in every respect resemble Subspecies or Varieties that have sprung from the same species.

In consequence of the intimate affinity that exists between Varieties of the same species, it is very obvious that all would readily produce intermediates, were it not, as has been exemplified, that the intercourse of some is completely prevented by their having secluded fructification,—while the intercourse of others is only limited by their flowering at different seasons, and by the distance that intervenes between the situations in which they grow.

To specify the exact distance at which Varieties that belong to the same species, and which are liable to mix, should be grown, in order to prevent their intercourse, would not be an easy task. Nor will any one think otherwise, when they reflect on the irregular state of that medium by which their intercourse is effected. A still and humid atmosphere may even prevent the diffusion of the pollen in the same flower; and as a wind that moves onward at the rate of twenty miles an hour, will carry it twice as far as a

wind the velocity of which is only ten miles, it is reasonable to infer that a distance which is sufficient to prevent the intercourse of Varieties at one time, will be found insufficient to prevent it at another. On this subject, however, we must consult experience, as the only rule of direction, in order to arrive at a decision; and in so doing, it will be found that the distance required to prevent the intercourse of Varieties that have exposed fructification, is far more circumscribed than, from many circumstances, we would be led to conclude.

Amongst the Subspecies or Varieties that are in general cultivation, it is probable that few, if any, require a greater distance to be kept between them, when in flower, than those of the different species of *Brassica*: yet all that have sprung from the same species, maintain their respective distinctions at the distance of two hundred yards, and it is rare that they mix when at half that distance. The different varieties of the gourd are prone to mix when growing contiguous to one another, as are those of the melon, and also of the cucumber: yet, at the distance of one hundred yards, they are never known to mix, nor have I ever known them to mix, even at a much less distance. The intercourse of the varieties that belong to the different species of *Thymus*, may extend to the distance of ten or twelve yards, but certainly not farther. The intercourse of the different varieties that belong to the cultivated species of *Lactuca*, is still more circumscribed; while the intercourse of such as belong to the different species of *Vicia*, *Phaseolus*, *Avena*, &c. is wholly prevented by the complete seclusion of the organs of generation. Indeed, if some botanists can be believed, there are species, like those of *Aristolochia*, that produce flowers in which the male and female organs are so situated, that im-

pregnation is not to be effected independent of the agency of insects. No one, however, who has ever beheld the exploding of the pollen, which in fine weather may be seen with the naked eye, in the *Urtica dioica*, and some other species, will readily acquiesce in the belief that insects are indispensably necessary to effect the intercourse of the sexes in any species whatever.

Were insects as officious in fertilizing plants, and in producing Varieties, as some have supposed them to be, it would be almost impossible to maintain any Variety in a state capable of transmitting its distinctions to posterity. Two or three hundred yards would yield no protection: miles would be required. But as certain Species and their Varieties, that are much frequented by bees and other insects, are known to maintain their respective distinctions when growing only at the distance of a few yards, it is a satisfactory proof that the sexual intercourse of plants is not materially affected by them.

THE END.

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